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FISHERY RESEARCH

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IN
FISH RESTORATION

PORTNEUF RIVER ASSESSMENT

Job Completion Report for 1986-1988
Project F-71-R-12, Subproject III, Job No. 4

A Cooperative Project of:

IDAHO DEPARTMENT OF FISH AND GAME
and
IDAHO STATE UNIVERSITY

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JOB COMPLETION REPORT

State of:	Idaho	Name: River & Stream Investigations
Project No.	F-71-R-12	Title: Portneuf River Assessment
Subproject:	III	Period Covered: May 1986 to May 1988
Job No.	4	

ABSTRACT

Sediment levels varied between transects on the upper Portneuf River, showing possible evidence of the effect macrophytes exert on sediment transport. For the period June through September 1986, transect D consistently had the greatest level of accumlated sediment. For the period July through October 1987, transect A sediment levels increased while those of transect D decreased. Average sediment depth for the study was 7.7 cm.

Diptera was the most numerous taxon in the benthos, accounting for 49.5% of the total abundance. It was followed by two species of Ephemeroptera (20.5%) and several Trichoptera species, with <u>Helicopsyche borealis</u> the most abundant. Invertebrate densities declined overall in 1987 as compared to those $_2$f 1986. Values ranged from 133 organisms/m^2 in 1987 to 76,400 organisms/m in 1986. Species richness at transect A ranged from 8 species in June 1986 to 25 in August 1986. Drift was also reduced in 1988 as compared to samples collected in 1979.

The aquatic herbicide, xylene, was lethal to test organisms at a distance of 7 km downstream of the injection site. The herbicide was not detected in the Portneuf River downstream of the application site in the Portneuf-Marsh Valley Canal.

More than fifty wild rainbow trout redds were located below the Anderson Bridge area. Lesser numbers were noted at the Slaughterhouse and Pebble Bridge sites. Spawning areas were associated with mid-channel islands.

A total of 2153 fish were collected by electrofishing selected river sections. Wild rainbow trout accounted for 67% of the total with cutthroat 24%. A total of 498 sexually mature wild rainbow trout were collected; 58% females and 42% males. Males preceeded females in readiness to spawn.

McNeil core results of fine sediments less than 6.3 mm ranged from 32.9% at the Anderson Bridge site to 88.7% at the Broxon Bridge site. Sediment levels increased within the redds over a four week period. Embryo survival was found by examination of two redds each from the Slaughterhouse and Anderson Bridge sites. A total of 417 eggs were collected at the two sites; 146 remained alive (35%) and 271 dead (65%).

INTRODUCTION

The Portneuf River upstream of the town of Lava Hot Springs in Bannock and Caribou Counties (Fig. 1) was until recently considered a 'blue ribbon' trout stream by the Idaho Department Fish and Game supporting an excellent wild trout population. Public perceptions of the river's deterioration prompted initiation of this study in January 1986. This research begins the assessment of current physical conditions of the river in selected locations. Biota, including fishes and aquatic macroinvertebrates, were also sampled. Additionally, Idaho Department of Fish and Game Region 5 personnel requested that two other areas of concern be addressed.

The first was to repeat an aquatic herbicide evaluation performed by Regional Fisheries Manager John Heimer in July 1973. The owners of the Portneuf-Marsh Vally Canal treat the waterway with an aquatic herbicide, xylene. Their intent is to minimize the aquatic plant growth along the canal sides and bottom. The plants are thought to impede the waters progress downstream, increasing water loss via infiltration. Public concerns were that significant numbers of game fish, particularly rainbow trout, were being poisoned in the canal. Also there was the potential that significant amounts of xylene might be reaching the main river.

The second was to establish the extent of spawning by rainbow trout (*Salmo gairdneri*) and cutthroat trout (*S. clarki*) in the upper portion of the river. The hope was that spawning areas could be found and possibly protected. This portion of the study was made in January through April 1987.

OBJECTIVES

The overall project objective was to evaluate sediment as a possible factor limiting trout populations in the upper Portneuf River. Specific objectives were to:

1. Estimate the amount of sediment being deposited annually within the river channel in the first 5 km of river downstream from the Portneuf-Marsh Valley Canal.

2. Assess the extent to which suspended sediments are being trapped and retained by aquatic macrophytes.

3. Determine whether species composition and/or abundance of aquatic macroinvertebrates have changed since the the study of Minshall and Andrews (1973) on benthos and that of Frazier (1979) on drift.

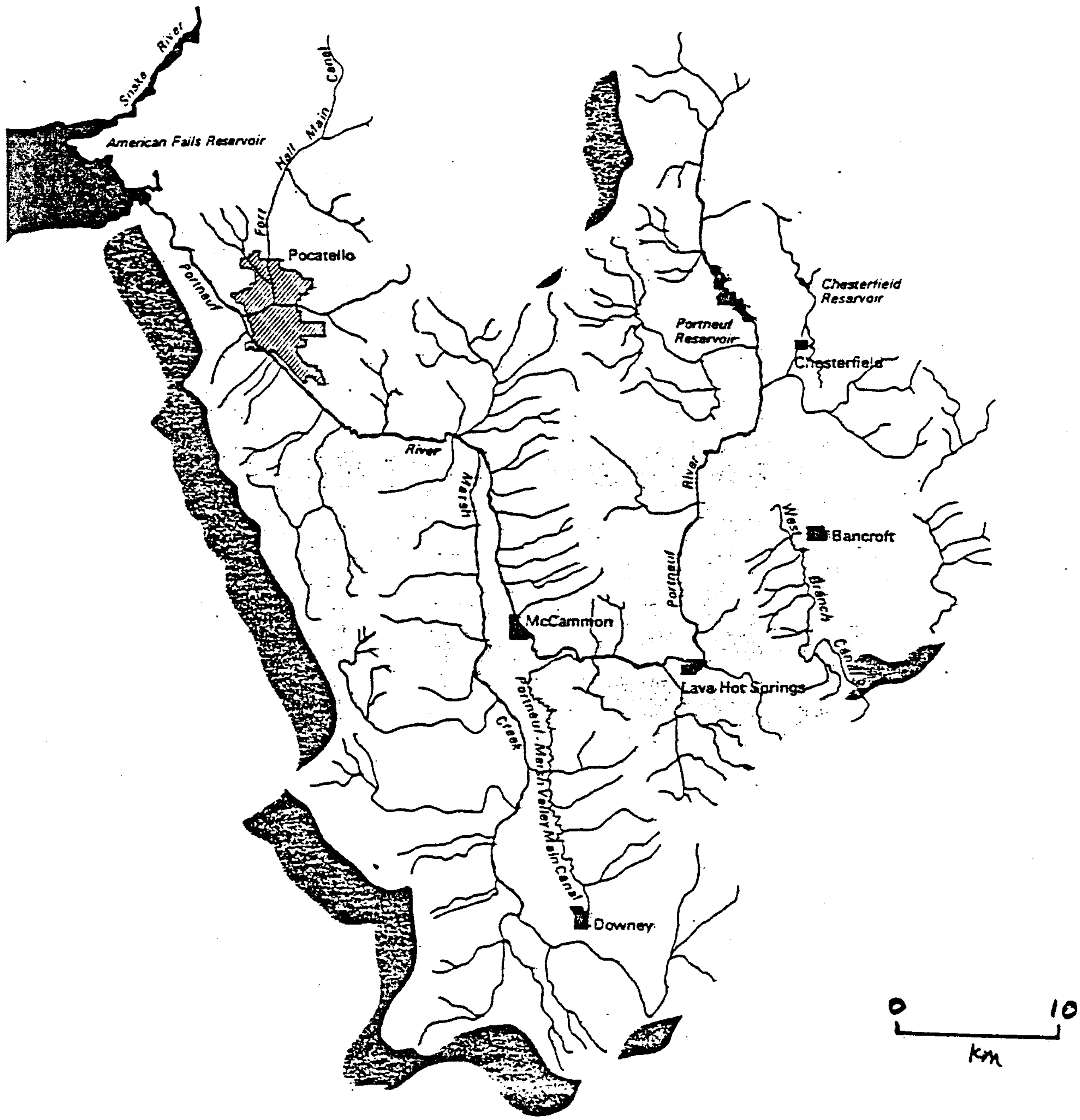

Figure 1. Map of the Portneuf River drainage basin.

4. Determine species composition and abundance of aquatic macroinvertebrates at sites of differing levels of sedimentation.

5. Assess the extent of reproduction of rainbow and cutthroat trout resulting from mainstem spawning.

DESCRIPTION OF STUDY SITES

Sediment. Invertebrate, and Macrophyte Evaluation

The Millward site is located 15.8 km below Chesterfield Reservoir extending downriver 450 m (Figure 2). Substrate varies from highly embedded cobble to areas of fine silts. Proceeding downriver, the macrophyte beds decrease in size and frequency, from mixed beds of water cress (*Rorripa nasturtium aquaticum*), crisp pondweed (*Potamogeton crispus*), Sago pondweed (*P. pectinatus*), and buttercup (*Ranunculus* spp.). Riparian vegetation consists of bluegrass (Poa spp.), wheatgrass (*Agropyron* spp.), rush (*Juncus* spp.), sedge (*Carex rostrata*), dock (*Rumex* spp.) and several thistle species (J. Freedman, personal communication).

The Pebble Creek site is located approximately 2.5 km downriver of the Millward site. Extensive riparian and aquatic vegetation is evident here. Willow stands are particularly dense in this area. Macrophyte composition and abundance are comparable to the Millward site. No channel characteristics were measured at this site.

Invertebrate drift samples were taken at a point 70 m below Pebble Bridge and at a site 30 m below the "Utah Bridge" location, an abandoned county bridge 14.5 km downriver from Chesterfield Reservoir.

Xylene Evaluation

Five study sites were selected for the xylene investgation. Four were located along the Portneuf-Marsh Valley Canal and the fifth along the main river channel at Utah Bridge at river kilometer 104.6 (Figure 2).

Site A was located 1.6 km downriver of Chesterfield Reservoir substrate consists of loosely packed gravels and silt. Narrow beds of mixed Sago pondweed and the filamentous green algae *Cladophora glomerato* occur near the banks (Minshall and Andrews 1973). Due to past (and possibly present) canal maintenance practices, riparian vegatation is limited to bunch grasses. The area is fenced to limit grazing along the banks.

Site B was located 214 m downriver of the Chesterfield LDS Church Road Bridge (6.4 km below Chesterfield Reservoir) at an elevation of 1622 m. Substrate composition and aquatic and riparian vegetation are comparable to the Chesterfield site. This area is also fenced.

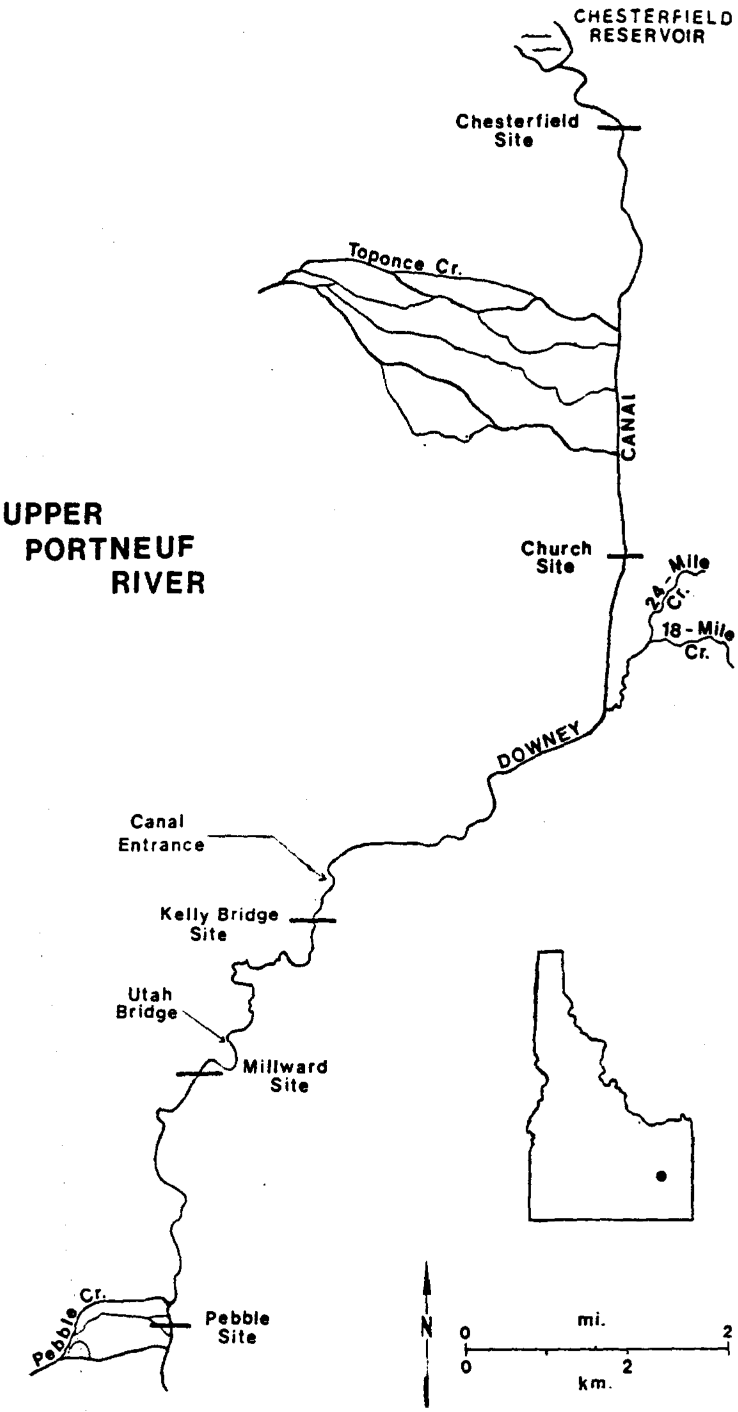

Figure 2. Portneuf River sedimentation study sites.

Site C was located 300 m upriver from the Kelly Road Bridge (12.5 km below Chesterfield Reservoir) above the confluence of the canal and the main stem of the Portneuf River The substrate appears to contain more fine sediments and is more compacted. Clumps of Sago pondweed are found in depositional areas behind large rocks and at the point of bars. Lush grasses and various forbs make up the riparian vegetation despite the fact that this area is routinely grazed.

Site D is located 60 m downriver of the Kelly Road Bridge (12.9 km below Chesterfield Reservoir). Macrophyte composition and abundance is comparable to site C.

Site E is located at Utah Bridge, 14.5 km downriver of Chesterfield Reservior. The substrate varies from highly embedded cobble to areas of fine silts. Macrophyte composition and abundance are comparable to the Millward site.

Spawning Activity

The section of the upper Portneuf River included in this study extends from the Steel Bridge on Chesterfield Road to Symons Bridge, a distance of 16.9 km. Within this area the river was divided into eight study sections ranging from 1.1 to 4.3 km. in length. All sections excluding Millward and Slaughterhouse begin at the named bridges. The Millward section extends from the upstream Otto Millward property line to the Hiway Lime Co. buildings. The Slaughterhouse section begins on the Michael Ellison property 100 m downstream of the dirt access road above the large river bend (Figure 3, Table 1).

METHODS

Sediment. Invertebrate, and Macrophyte Evaluation

Sediment Deposition and Retention

To estimate sediment deposition below the Portneuf-Marsh Valley Canal, transect lines were established following the procedures of Platts, Megahan, and Minshall (1973). Single line transects were used at each location. Sites were selected with the intent of pair-wise comparisons of data, i.e., transect A vs. transect C, transect B vs transect D. Metal posts were driven into the banks at the high water mark to serve as the endpoint of the transect. A metal cable marked at 0.5 m intervals was stretched taut between the two end-points to provide measurement of horizontal distance of the channel. Sediment depth was determined by pushing the end of a meter stick into the substrate to the point where downward progress stopped. Water velocity was measured using a Marsh-McBirney Model 201 velocity meter. Macrophyte location and area covered at the intersection with the transect were recorded.

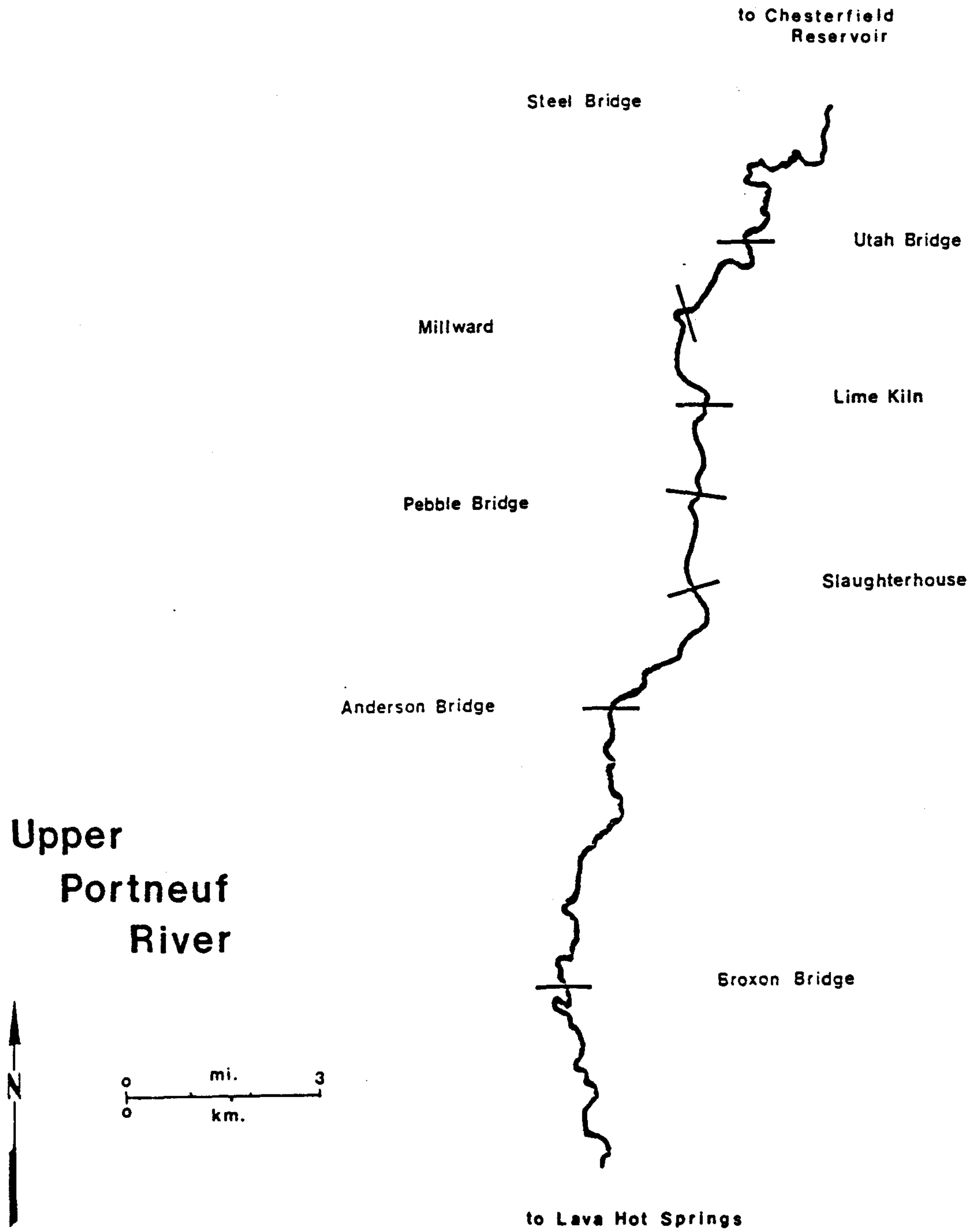

Figure 3. Map showing upper Portneuf River spawning study sites.

Table 1. Electrofishing sections for the upper Portneuf River, spring 1987.

Sections	River kilometer	Length (km)	Gradient (%)
Steel Bridge	112.2	2.9	0.3
Utah Bridge	109.3	1.8	0.3
Millward	107.5	1.1	0.3
Lime Kiln	106.4	1.5	0.3
Pebble Bridge	104.9	1.1	0.3
Slaughterhouse	103.8	2.1	1.0
Anderson Bridge	101.7	4.3	0.6
Broxon Bridge	97.4	2.1	0.3

Macroinvertebrate Composition. Density. and Abundance

At the Millward site, aquatic macroinvertebrates from locations differing in levels of sedimentation were collected during the study period. A modified Hess net with a mesh size of 0.24 mm was used to collect quantative samples of benthic organisms. The area enclosed by the net measured 0.06m . The substrate was stirred to a depth of 12 cm. Samples were made at predetermined distances upriver of the individual transect lines to avoid disruption of the transect area. For each successive sampling period, the collection points were moved upstream a prescribed distance to eliminate repeat sampling of an area. Three samples per transect were collected during a sampling period, except at transect D where five were taken. Sampling alternated between erosional and depositional areas. Samples were preserved in 3% formalin solution and returned to the lab. Subsampling was undertaken for samples containing large numbers of organisms (Waters 1969). Taxa were indentified to the lowest feasible level (usually genus). Transects were sampled at two week intervals in June and July and monthly August through November 1986. Monthly samples were taken in January, March, April and July through October 1987.

The Pebble Creek site identified by Minshall and Andrews in their 1972 study (in the main stem at the mouth of Pebble Creek) was sampled on 31 July and 28 October 1986, 1 Feburary and 14 July 1987. This sampling frequency follows the 1972 study protocol. Five Hess net locations roughly equally spaced across the channel were sampled.

Invertebrate drift was collected in May through July of 1988 to correspond with similar data collected by Frazier in 1979. During each of two month-long intervals (26 May to 22 June and 24 June to 24 July), two 15 by 30 cm nets with 250 um mesh were set for 10 minutes at 2-hour intervazls from 0900 to 2100 hours Pacific Daylight Time. Data from each month-long interval were pooled to represent numbers of invertebtates captured in the 130 m^3 of water filtered at each site (Utah and Pebble Bridges).

A Ryan-Peabody recording thermograph was installed at Transect D on July 2. A water level staff gauge was attached to the thermograph anchor post.

Xylene Evaluation

Ten fingerling rainbow trout (88 per kilogram) were placed in a single minnow trap at each of the five sites. The traps measured approximately 41 cm long and 21 cm in diameter with two funneled ends. A kick net was used to collect a group of macroinvertebrates from the canal substrate. These were placed in metal can having both ends covered with 0.039 mm mesh. The cans measured 17 cm in length and 15 cm in diameter. The cans were secured to the channel bottom by attachment to rebar diven into the substate. Care was taken to position the animals in areas of the greatest depth and moderate to low velocities. The live boxes were positioned on July 15.

Water samples collected in 100 ml amber screw top bottles were taken at approximately one hour intervals at each site. Two samples were taken per interval, one just below the water surface the, other at one-half the total water depth. The samples bottle were imediately placed in iced cooler to avoid loss of the volatile xylene. The samples were analyzed by John Knutson at Could Semiconductor Inc. in Pocatello: A mass spectrometer capable of detecting 1-2 parts per billion was used to analyze the samples. The live boxes were retrieved and any mortalities were noted at each interval.

Spawning Activity

To evaluate the extent of spawning substrate available, the river was floated twice in a drift boat. Areas of apparently suitable substrate were recorded and later monitored for signs of spawning activities. When observed, redd locations were also noted.

The individual sections were sampled twice during the period (Table 2) using an aluminum drift boat equipped with electrofishing gear. Gear used included a 5000 watt generator, Coffelt variable voltage pulsator (VVP-15), and a single fixed boom electrode. The hull of the boat served as the cathode for pulsed DC operation.

Spawning readiness of fish collected was assessed by external examination. The following index was applied:

Condition 1. no external sexual characteristics (juveniles)

Condition 2. fish can be sexed visually but without the obvious features noted below.

Condition 3. definite signs of maturation: i.e., females with swollen abdomens, elongated anal fins, swollen vents and males with kype jaws and darkened body color. These fish will most likely spawn within two to three weeks:

Condition 4. milt or eggs could be extruded - fish ripe.

To evaluate movements, trout larger than 150 mm were fin-clipped using batch marks. Upon recapture, individuals were tagged with jaw tags. Hatchery trout were not marked.

To assess fine sediment quantities present, fifteen McNeil cores were taken both in the general area and within several identified redds to depths of 15 cm. On January 31 within the Millward section:

1. a single core along a transect line established by T. Burton (USFS) and D. Schill (IDFG) for a USFS-GAWS assessment,
2. a single core 50 m downstream near the west bank of the mid-channel island.

On February 1 within the Slaughterhouse section, immediately below the Slaughterhouse :

1. two cores from a small side channel along the west bank,
2. a single core from the main channel immediately below a gravel bar.

Table 2. Electrofishing sections, sampling dates, associated batch marks and recaptures for the upper Portneuf River, spring 1987.

Sections	Batch marks	Number			Sampling dates	
		(M)	(C)	(R)	1st	2nd
Steel Bridge	anal clip	274	310	30	Feb. 12	March 2
Utah Bridge	dorsal punch	79	93	2	Jan. 31	March 3
Millward	right pectoral clip					March 3
Lime Kiln	left pelvic clip					March 3
Pebble Bridge	mid caudal punch	122	109	5	Jan. 31	March 3
Slaughterhouse	bottom caudal punch	201	159	10	Feb. 7	March 1
Anderson Bridge	top caudal punch	195	256	12	Feb. 8	March 1
Total		871	927	59		
Broxon* Bridge	dorsal punch	64		3	Feb. 8	

* = section not resampled

Cores were taken at four separate locations on February 26:

1. approximately 0.8 km below the Steel Bridge in a riffle area,
2. immediately downstream of the Slaughterhouse in the main river channel,
3. 0.5 km upstream of the Anderson Bridge in the previously identified spawning area,
4. immediately downstream of the Broxon Bridge in a previously identified spawning area.

Core samples were wet-seived and the percent by weight of fines less than 6.3 mm in diameter was recorded.

To monitor suspected changes in the amount of percent fines within the redd, wooden boxes (26.5 cm square x 5 cm deep) were positioned open side up in selected redds. Four boxes per site were located in the Broxon Bridge, Anderson Bridge and Slaughterhouse sections in identified spawning areas. The boxes were filled with local substrate containing the average percentage fines calculated for each site from the McNeil cores samples. A single box from each site was recovered each week. The percent fines less than 6.3 mm present was compared to the McNeil core average for that site.

Gradient at each location was measured with a stadium rod and level.

RESULTS AND DISCUSSION

Sediment. Invertebrate, and Macrophyte Evaluation

Sediment Deposition and Retention

Sedimentation levels varied between transects, showing possible evidence of the effect macrophytes exert on sediment transport. For the period June through September 1986, sediment depths for transects A, B, and C were quite similar (Tables 3-6, Figure 4). Transect D had consistently higher values. The second consecutive period was July through October 1987, during which depths of transect D decreased while those of transect A increased. In contrast to the summer of 1986 when transect D had extensive aquatic macrophyte beds; the beds were much reduced in 1987. The average sediment depth from all transects through the entire study was 7.7 cm.

The amount of material that is being deposited downriver of the canal appears to be a small portion of total sediment transport. If values are extrapolated to provide a 7.7 cm thick layer of sediment covering the 5.1 km distance downstream from Kelly Bridge, a total of 19,250 kg/yr of materials would be deposited. This value compares to Hoover's (1985) estimate of 7,258 kg/day moving under Kelly Bridge during the month of September.

Table 3. Channel characteristics of transect A on the upper Portneuf River, 1986-87, standard deviation : (SD).

Date	Mean Water Depth(cm)	(SD)	Mean Sediment Depth(cm)	(SD)	Mean Water Velocity (ft/sec)	(SD)	Sample Size (N)
June	18.7	(4.8)	1.1	(2.3)	1.1	(.4)	81
Aug.	36.3	(7.7)	1.4	(1.7)	1.4	(.7)	87
Sept.	40.7	(8.0)	1.6	(2.6)	1.2	(.8)	87
Oct.	28.1	(6.9)	2.7	(3.8)	1.0	(.8)	85
March	19.4	(5.8)	2.4	(3.2)	1.3	(.5)	84
April	19.8	(6.2)	2.5	(3.1)	1.2	(.6)	85
Aug.	46.0	(9.1)	5.7	(6.0)	.7	(.6)	179
Sept.	36.7	(7.6)	4.9	(5.1)			88
Oct.	22.8	(7.2)	4.6	(4.4)	.8	(.6)	86

Table 4. Channel characteristics of transect B on the upper Portneuf River, 1987, standard deviation : (SD).

Date	Mean Water Depth(cm)	(SD)	Mean Sediment Depth(cm)	(SD)	Mean Water Velocity (ft/sec)	(SD)	Sample Size (N)
June	35.9	(13.2)	2.9	(4.6)	.9	(.8)	59
July	45.8	(14.5)	2.4	(5.3)	1.0	(.6)	171
Aug.	54.2	(18.6)	3.8	(5.8)	1.0	(.7)	67
Sept.	58.5	(19.9)	3.8	(6.4)	1.1	(2.1)	62
Oct.	46.9	(15.3)	3.5	(5.4)	.7	(.5)	58
March	36.0	(15.1)	5.3	(6.9)	.9	(.4)	56
April	35.7	(16.6)	7.2	(7.8)	.7	(.4)	57
July	55.9	(12.5)	10.8	(10.1)	.7	(.6)	63
Aug.	59.5	(20.1)	10.2	(8.6)	.5	(.5)	121
Sept.	46.1	(17.8)	10.4	(7.9)			60
Oct.	40.0	'(17.6)	12.0	(7.5)	.5	(.4)	59

Table 5. Channel characteristics of transect C on the upper Portneuf River, 1986-87, standard deviation : (SD).

Date	Mean Water Depth(cm)	(SD)	Mean Sediment Depth(cm)	(SD)	Mean Water Velocity (ft/sec)	(SD)	Sample Size (N)
June	21.7	(7.1)	1.0	(1.7)	1.1	(.6)	66
July	32.2	(8.0)	1.0	(2.0)	1.4	(1.4)	206
Aug.	45.3	(9.4)	2.2	(3.5)	1.3	(.9)	70
Sept.	50.3	(9.3)	1.9	(2.8)	1.0	(1.0)	70
Oct.	34.9	(8.2)	2.4	(2.4)	.9	(.9)	70
March	26.2	(8.7)	2.7	(3.9)	1.3	(.4)	69
April	26.4	(8.2)	2.7	(4.1)	1.1	(.5)	69
July	50.5	(7.9)	3.9	(4.9)	1.0	(.9)	69
Aug.	51.6	(7.9)	4.6	(5.5)	.6	(.6)	142
Sept.	41.8	(6.1)	3.2	(4.7)	--	--	70
Oct.	36.4	(7.8)	6.7	(5.4)	.5	(.3)	71

Table 6. Channel characteristics of transect D on the upper Portneuf River, 1986-87, standard deviation : (SD).

Date	Mean Water Depth(cm)	(SD)	Mean **Sediment** Depth(cm)	(SD)	Mean Water Velocity (ft/sec)	(SD)	Sample Size (N)
June	25.6	(12.3)	9.3	(11.6)	.7	(.8)	83
July	35.0	(12.8)	8.5	(10.8)	.8	(1.1)	255
Aug.	50.3	(16.4)	7.8	(9.0)	.8	(.8)	92
Sept.	55.0	(17.8)	8.1	(9.3)	.7	(.9)	88
Oct.	43.6	(12.4)	8.6	(8.8)	.5	(.6)	85
March	17.9	(8.8)	7.1	(7.4)	1.3	(.7)	86
April	17.0	(7.8)	5.9	(6.4)	1.2	(.7)	86
July	26.7	(8.2)	6.1	(5.9)	1.3	(.9)	85
Aug.	33.9	(8.3)	6.2	(6.4)	.8	(.8)	170
Sept.	27.7	(8.2)	5.9	(5.6)	--	--	85
Oct.	26.7	(7.8)	8.3	(6.2)	.6	(.6)	85

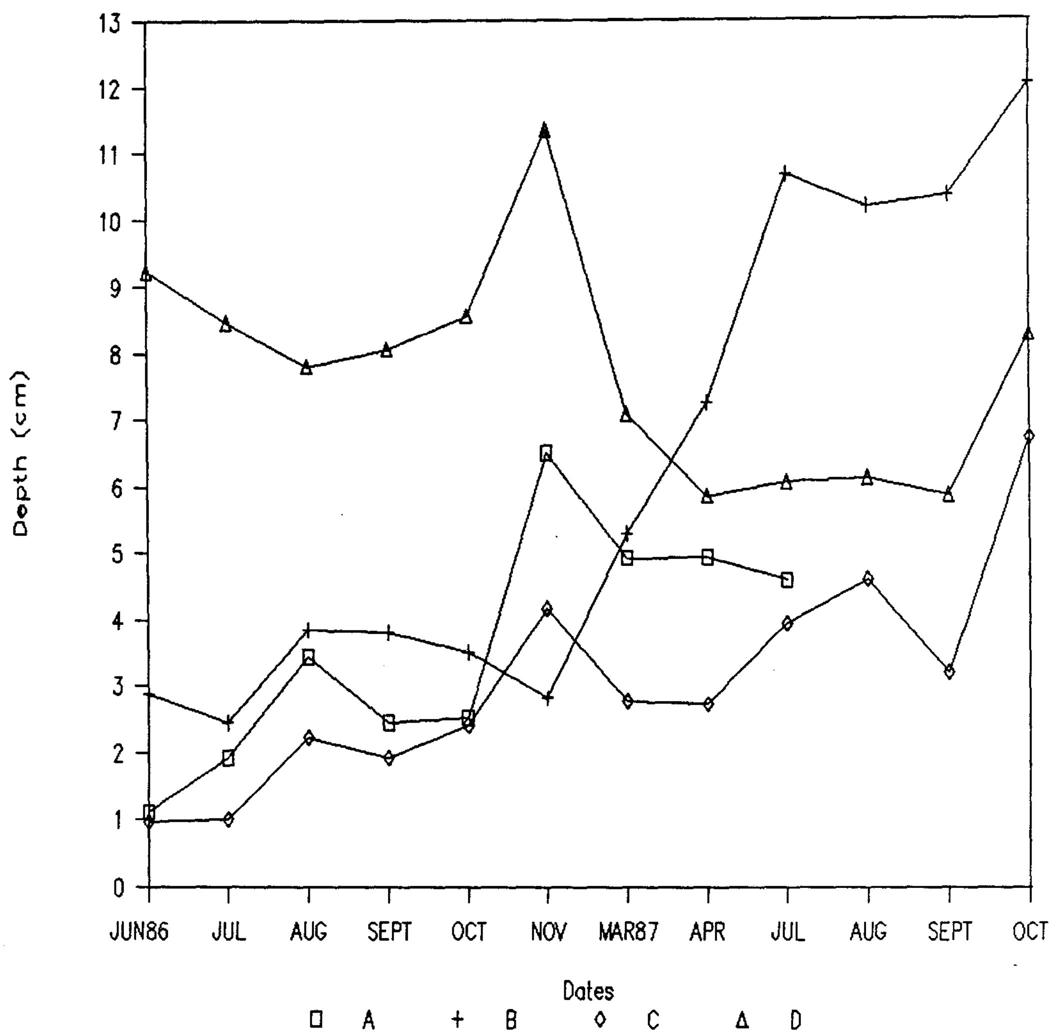

Figure 4. Average sediment depth along transects at the Millward study site, upper Portneuf River, 1986-1987.

Current velocity and water depth reported by Minshall and Andrews (1973) at their Station 1 (at the mouth of Pebble Creek) averaged 52 cm/sec water depth from the Millward study site for this study averaged 25 cm/sec and 35.3 cm.

Macroinvertebrate Comvosition. Density. and Richness

Diptera was the most numerous taxon collected in benthos sampling, accounting for 49.5 % of total abundance. The family Chironomidae comprised 80% of the true flies collected. Ephemeroptera was next, accounting for 20.5% of total abundance. The species Tricorythodes minutus and Ephemerella inermis were the most numerous ephemeropterans. Trichoptera was third in order of total abundance at 14%, and a single species Helicopsyche borealis accounted for 78% of the total. The annelid worm Tubifex sp., snails Amnicola, Lymnaea and Physa and the clams Pisidium and Sphaerium were also commonly collected (Figures 5-8).

Invertebrate densities were greatly reduced in the 1987 benthic samples from all transects and habiats as compared to 1986 collections. Values ranged from 133 organisms/m^2 at transect C on 16 July 1987 to 76,400 organisms/m^2 at transect D on 27 June 1286 (Tables 7-10). Average density from all samples was 16,392 organisms/m . Species richness values ranged from 8 total taxa at transect A on 17 June 1986 to 25 total taxa at transect A on 8 Aug 1986. An expected inverse relationship between density and richness was not evident.

Invertebrate drift collected in 1988 also showed a distinct reduction in diversity and abundance from that collected in 1979 (Table 11). As few as 14 and as many as 26 taxa had been collected in 1979; this dropped to 5-7 taxa in 1988. Numbers of drifting invertebrates declined drastically in all but one instance.

Average water temperatures at Station 2 during the periods September 25 through December 4, 1969, ranged from 4.4 to 15.6 C and on April 8 through June 18, 1970, ranged from 7.7 to 25.6 C. Water temperatures from the Millward site on September 25 through December 4, 1986, ranged from 3.5 to 17.8 C and on April 1 through June 30, 1987, ranged from 9.3 to 17.0 C (Figure 9).

Xylene Evaluation

Herbicide treatment of the Portneuf-Marsh Valley Canal began at 0930 PDT on 15 July 1986. A fifty-five gallon drum of xylene was pumped into the canal below the outlet of Chesterfield Reservoir, 1.6 upstream of site A. Canal discharge was reduced to 25 cfs just prior to the treatment. Discharge was increased to 105 cfs at 1430. No attempt was made to moderate the abrupt changes in discharge.

All fish and macroinvertebrates were killed at sites A and B within two hours of the treatment (Table 12). No mortalities of either fish or macroinvertebrates were evident within twelve hours downstream. Traces of xylene were detected only at sites A and B.

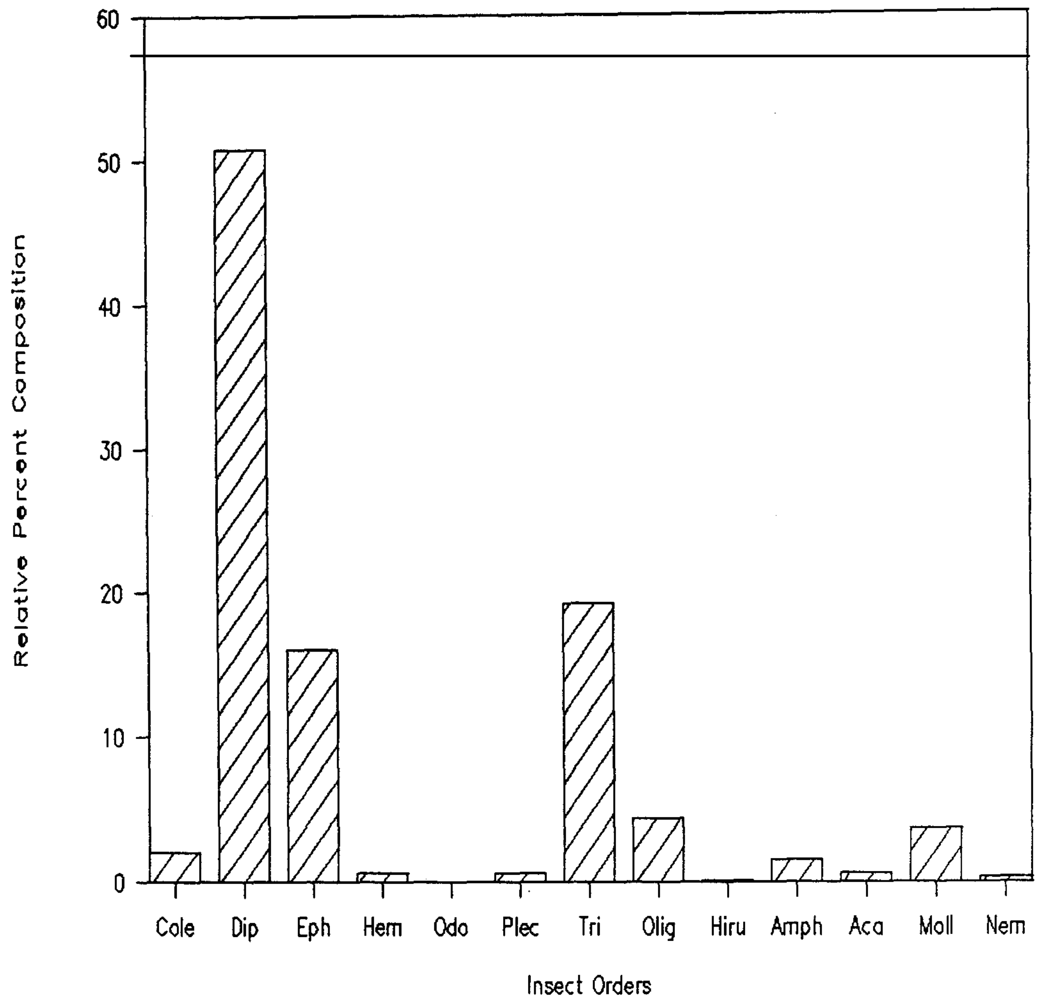

Figure 5. Relative percent composition by order of aquatic invertebrates collected along transect A at the Millward study site, 1986-1987.

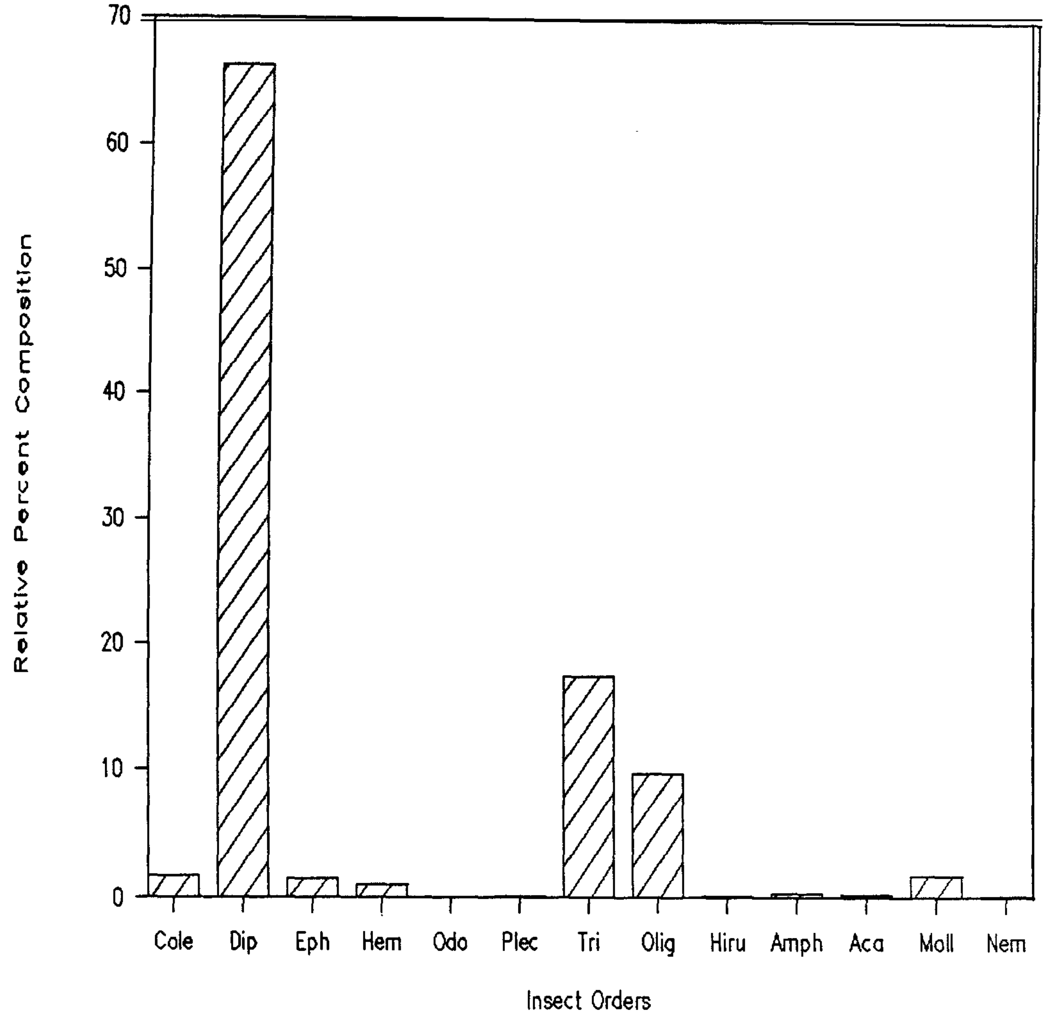

Figure 6. Relative percent composition by order of aquatic invertebrates collected along transect B at the Millward study site, 1986-1987.

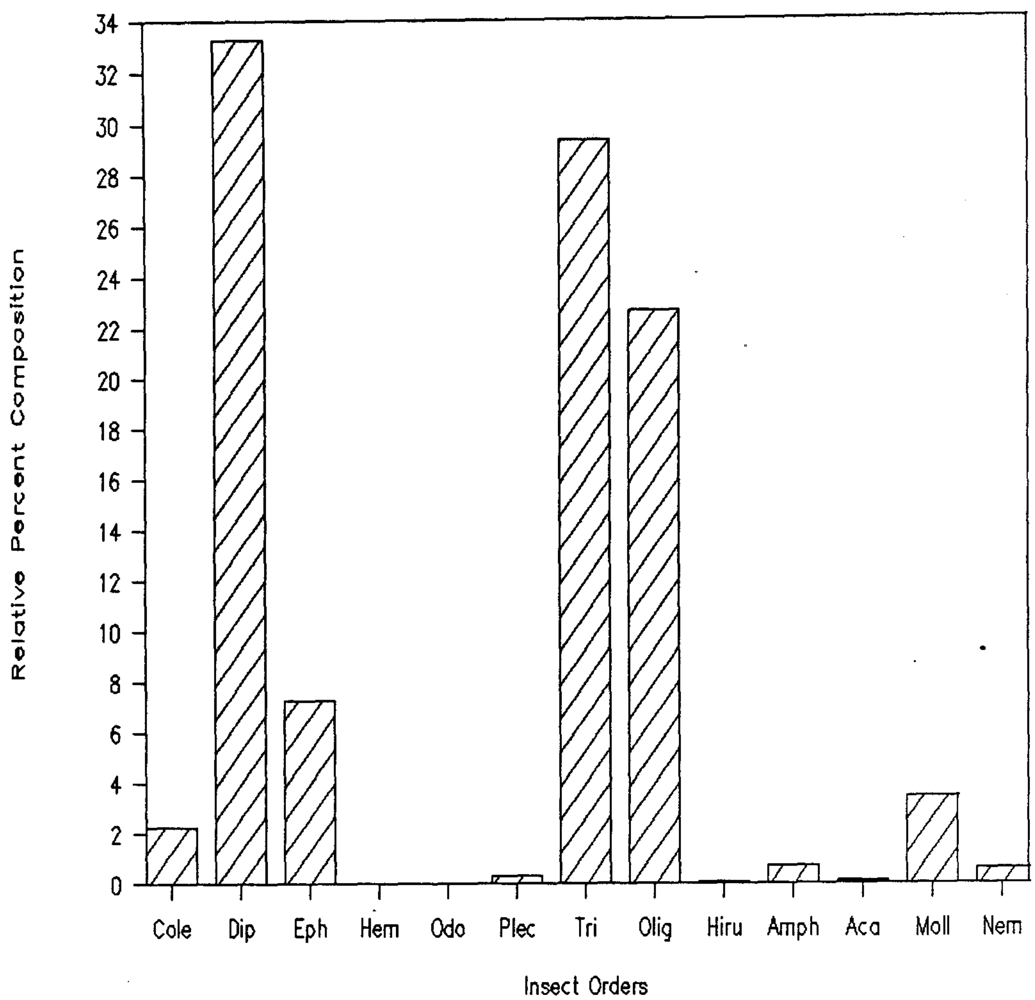

Figure 7. Relative percent composition by order of aquatic invertebrates collected along transect C at the Millward study site, 1986-1987.

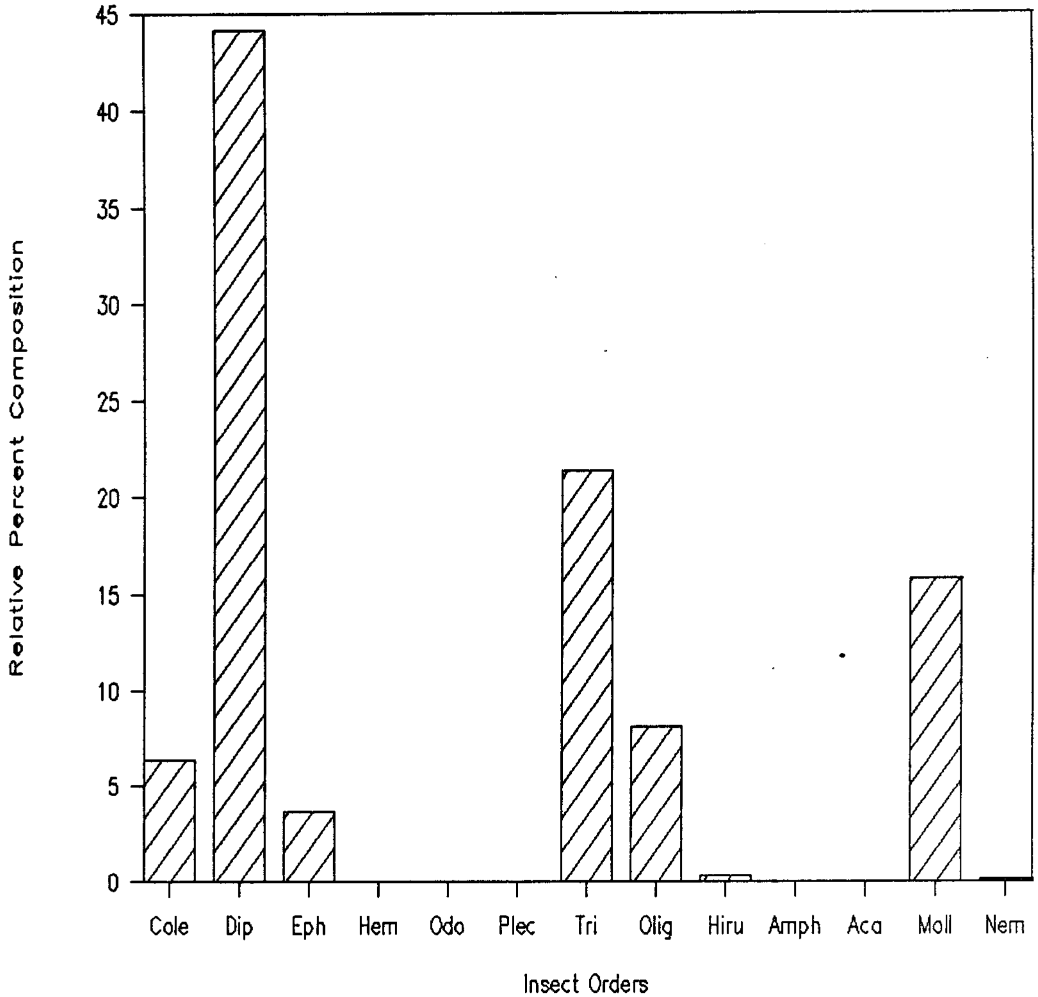

Figure 8. Relative percent composition by order of aquatic invertebrates collected along transect D at the Millward study site, 1986-1987.

Table 7. Density (number/meter^2) and richness (total number of taxa) of macroinvertebrates at transect A, 1986-1987.

Date	Sample Number	E/D*	Density	Richness
10 Jun 1986	8	E	4,617	14
17 Jun 1986	6	E/D	16,583	8
8 Aug 1986	1	E	16,883	21
	2	E	16,550	25
	4	E	22,717	22
22 Aug 1986	4	D	13,200	13
16 Jul 1987	5	E	8,933	9
20 Aug 1987	1	E	10,800	6
21 Oct 1987	6	D	500	6

* E : Erosional site
D : Depositional site

Table 8. Density (number/meter^2) and richness (total number of taxa) of macroinvertebrates at transect B, 1986-1987.

Date	Sample Number	E/D*	Density	Richness
17 Jun 1986	6	D	16,415	10
25 Jul 1986	1	E	6,933	14
	3	D	49,717	10
	5	D	12,783	15
8 Aug 1986	2	E	11,833	17
	5	D	22,717	18
11 Oct 1986	1	E	17,783	17
	3	E	11,500	17
	4	D	16,150	9

* E : Erosional site
D : Depositional site

Table 9. Density (number/meter^2) and richness (total number of taxa) of macroinvertebrates at transect C, 1986-1987.

Date	Sample Number	E/D*	Density	Richness
8 Aug 1986	4	E	**13,950**	17
	5	D	28,117	16
7 Jul 1987	2		133	4
20 Aug 1987	6	E	283	5

*E : Erosional site
D : Depositional site

Table 10. Density (number/meter^2) and richness (total number of taxa) of macroinvertebrates at transect D, 1986-1987.

Date	Sample Number	E/D*	Density	Richness
11 Jun 1986	1	E	16,350	13
	4	D	8,000	12
27 Jun 1986	3	E	29,967	24
	7	D	76,400	18
8 Aug 1986	1	E	20,983	17
	5	D	15,417	18
	6	E	11,117	21
11 Oct 1986	3	E	21,567	19
	7	D	33,733	20
16 Jul 1987	6	D	2,667	7

* E : Erosional site
D : Depositional site

Table 11. Invertebrate drift collected from 130 m3 water samples from the Utah Bridge and Pebble Bridge stations on the Portneuf River during 1979 and 1988.

	Utah Bridge				Pebble Bridge			
	26 Mav-23 Jun		24 Jun-20 Jul		26 Mav-23 Jun		24 Jun-20 Jul	
Taxon	1979	1988	**1979**	1988	1579	1988	1979	1988
Trichoptera								
Helicopsychidae:Helicopsyche	4	0	3	0	12	0	1	0
Brachycentridae:Brachvcentrus	3	0	1	0	5	2	1	0
Amiocentrus	7	0	10	0	48	0	0	0
Lepidostomatidae:Lepidostoma	0	0	0	0	62	0	0	0
Hydroptilidae	0	0	1	0	0	0	0	0
Diptera								
Chironomidae	43	81	118	**69**	28	56	89	131
Simulidae:Simulium	4	0	11	0	4	0	3	0
TipulidaesTipula	1	0	0	0	1	0	0	0
Ephydridae	0	0	1	0	0	0	0	0
Ephemeroptera								
Ephemerellidae:Ephemerella	**498**	18	72	3	100	15	11	2
Baetidae:Baetis	23	15	10	4	9	5	2	2
Leptophlebiidae:Paraleptophlebia	25	0	4	0	8	0	0	0
Tricorythidae:Tricorythodes	1	0	6	0	0	0	1	0
Coleoptera								
Elmidae:Ontioservus	4	0	3	0	3	1	0	0
Haliplidae:Haliplus	1	0	1	0	1	0	0	0
Dytiscidae:Dytiscus	1	0	1	0	0	0	0	0
Hymenoptera								
Formicidae	3	0	3	0	1	0	1	0
Homoptera								
Aphidae	2	0	1	0	0	0	3	0
Plecoptera								
Perlodidae:Isoperla	5	0	2	0	1	0	1	0
Chloroperlidae:Alloperla	0	0	0	0	1	0	0	0
Hemiptera								
Corixidae	1	0	2	1	5	0	2	0
Odonata								
Coenagrionidae:Hvponeura	0	0	0	0	1	0	0	0
Mollusca								
Planorbidae:Gvraulus	15	0	3	0	4	0	3	0
Physidae:Phvsa	6	0	29	1	6	0	6	1
Hydrobiidae:Amnicola	0	0	5	0	4	0	0	0
Lymneidae:Lymnea	1	0	1	0	0	0	0	0
Arachnida								
Hydracarina	3	0	5	0	1	0	0	1
Cladocera								
Daphnidae	1191	36	0	0	10	2	0	1
Amp hipoda								
Talitridae:Hvallella	0	3	4	0	1	2	0	1
Gammaridae:Gammarus	0	1	1	0	0	0	0	0
Annelida								
Tubificidae	0	0	2	0	1	0	3	0
Total	1842	152	303	78	317	83	127	139
Number of taxa	22	6	26	5	24	7	14	7

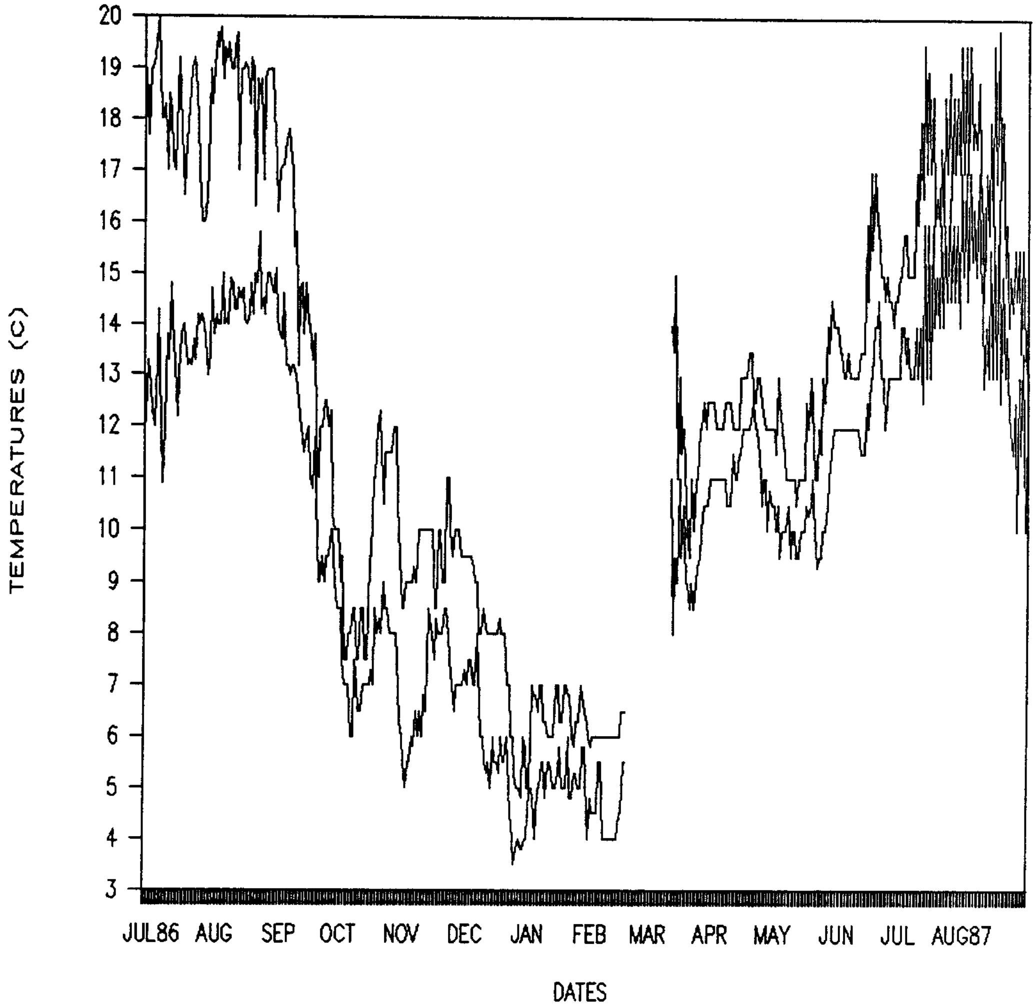

Figure 9. Maximum and minimum water temperatures recorded at the Millward study site, July 1986 through September 1987.

Table 12. Macroinvertebrates present at xylene monitoring sites, Portneuf-Marsh Valley canal, 15 July 1986.

Taxon	Site A	Site B	Site D	Site E
Coleptera				
Dysticidae:Agabus sp.	X	X		
Elmidae:sp.			X	X
Ootioservus			x	
Diptera		X	X	
Rhagionidae:Atherix variegata	X			
Chironimidae	X	X	X	X
Simulidae:Simulium sp.	X	X	X	
Tipulidae:Tipula **sp.**				x
Ephemeroptera				x
Baetidae:Baetis sp.	X			x
Ephemerellidae:Ephemerella inermis			x	
Heptageniidae	X			
Tricorythidae:Tricorythodes minuntius		X	X	X
Hemiptera				
Corixidae:Hesperocorina sp.		X		
Odonata				
Gomphidae:Ophiogomphus sp.			X	
Coenagrionidae	X			
Plecoptera				
Perlodidae:Isoperla mormona				x
Trichoptera		X		
Brachycentridae:Aminocentrus sp.		X	X	X
Brachycentrus **sp.**			X	X
Helicopsychidae:Heliocopsyche borealis			X	X
Hydropsychidae:Hydropsyche sp.			X	X
Hydroptilidae	X	X		
Lepidostomatidae:Lepidostoma sp.				X
Haplotaxidae				
Tubificidae:Tubifex sp.	X	X	X	X
Pharyngobdellida				
Erpobdellidae:Erpobdella sp.	X			
Helobdella sp.	X	X	X	
Amphipoda				
Talitridae:Hyallella azeteca	X	X	X	X
Gammaridae:Gammarus lacustris	X	X	X	X
Mesogastropoda				
Hydrobiidae:Amnicola sp.			X	
Basommatophora				
Planorbidae:Gyraulus	X	X		X
Physidae:Phvsa ampullacea	X	X	X	X
Sphaeriidae:Pisidium sp.	X		X	X
Sphaerium sulcatum			X	X
Nematoda			X	
Tricladidae				
Planaridae:Dugesia			X	

The herbicide concentration was sufficient to kill the test organisms within 7 km of the application site. At greater distances the xylene was so dilute that it was undetectable. Local concerns that the herbicide is reaching the Portneuf River 12.1 km downstream of the application site appear to be unfounded.

Spawning Activity

Redd Locations

More than fifty redds were located along both sides of a mid-channel island immediately above the Anderson Bridge within the Slaughterhouse section. This area was by far the most productive site, and redds may have been superimposed on each other at the Anderson Bridge site. Some thirty redds were noted at the Broxon Bridge, also associated with a mid-channel island. The only other area of any redd concentration was just below a large spring entering along the west bank midway between the Slaughterhouse and Anderson Bridge where approximately ten redds were noted. Isolated redds were found infrequently from Pebble Bridge downstream. These sites contained from one to three redds and probably represented less than fifteen total. Only two redds were located between Steel Bridge and Pebble Bridge.

The two areas of concentrated spawning activity were associated with mid-stream islands, resulting in increased velocities. The gradient profile through these areas was steepened as compared to the other sections (Figure 10), resulting in less deposited fine sediments.

Rainbow Trout Population

A total of 2153 fish were collected. Wild rainbow trout accounted for 67% and cutthroat trout 24% (Table 13).

A regression of scale radius against total body length was used to back-calculate average fish lengths (Table 14). Grouped length-frequency distribution are presented in Figure 11. Distributions for individual sections are shown in Figures 12 through 24. Size of younger fish may be affected by out-movement of age 0 and I fish from Pebble Creek. Sampling in Pebble Creek near its mouth in November and December 1986 indicated substantial numbers of trout in the 80-100 mm size category.

A total of 498 mature wild rainbow trout was collected through the sampling period. The sex ratio was roughly equal, with females the majority (58%) for the second sampling (Table 15). The Anderson Bridge section produced the largest numbers of mature individuals (161) followed by the Slaughterhouse (102) and Pebble Bridge (86) sections.

Maturity or readiness to spawn varied with the collection period. In period I, January through March 10, the majority of males (80%) were condition 4 (ripe) while the females remained in condition 3(62%). During period II, March 10 through April 10, the males remained in condition 4 (61%) while the females progressed to condition S or spent. The length - frequency distribution of the spawners (Figures 25 and 26) indicates

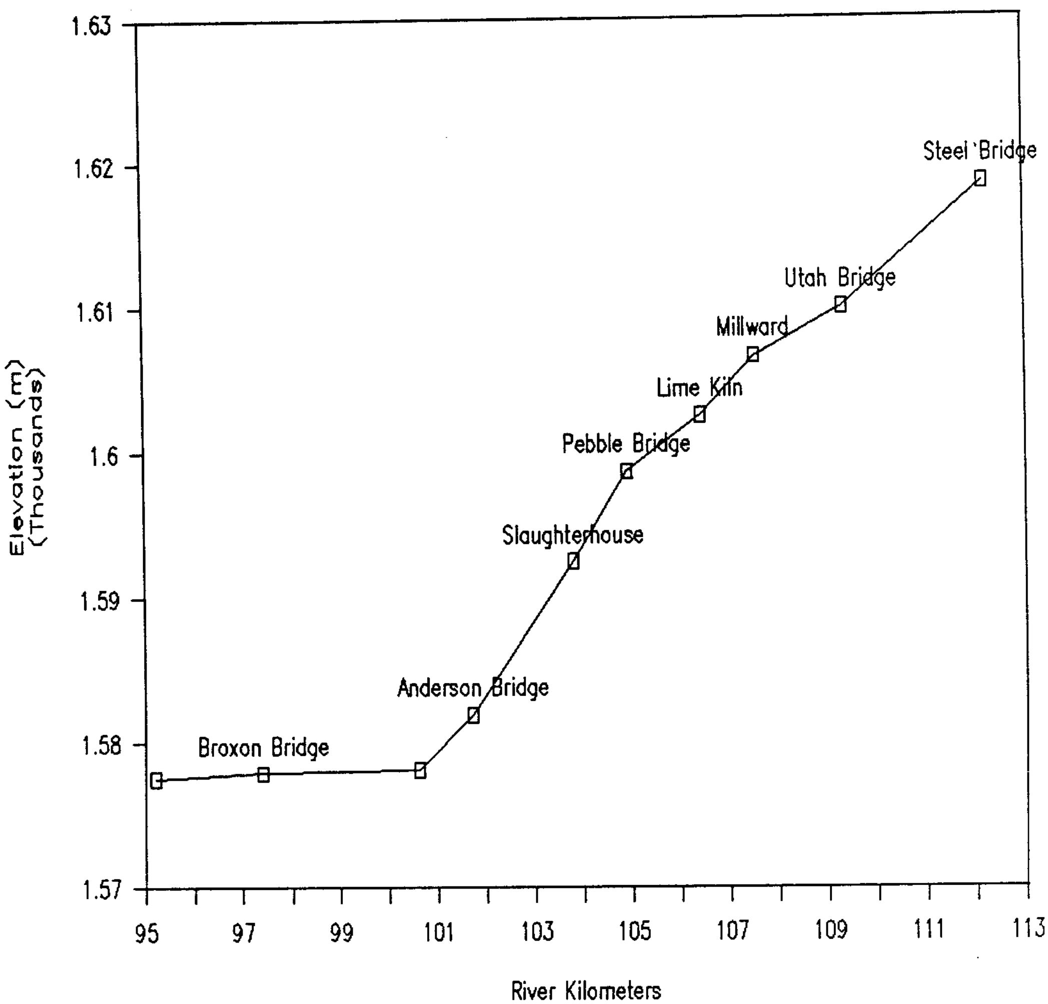

Figure 10. Gradient profile of the upper Portneuf River, spring 1987.

Table 13. Total numbers of rainbow trout collected by electrofishing the upper Portneuf River, spring 1987.

	Total numbers	Percent of total
Wild rainbow trout	1450	67
Hatchery rainbow trout	132	6
Cutthroat trout	515	24
RB/CT hybrid	40	2
CT/RB hybrid	16	1
Total fish	2153	100

Table 14. Average back-calculated lengths of rainbow trout collected in upper Portneuf River in spring 1986 and comparison with 1978 data.

Age at capture	Number	Calculated length at end of growing season				
		1	2	3-	4	5
I	59	126				
II	39	126	220			
III	19	118	206	295		
IV	6	119	208	293	373	
V	3	126	190	273	330	404
All	126	125	214	292	358	404
Wilkosz, 1978	61	130	196	276	371	----

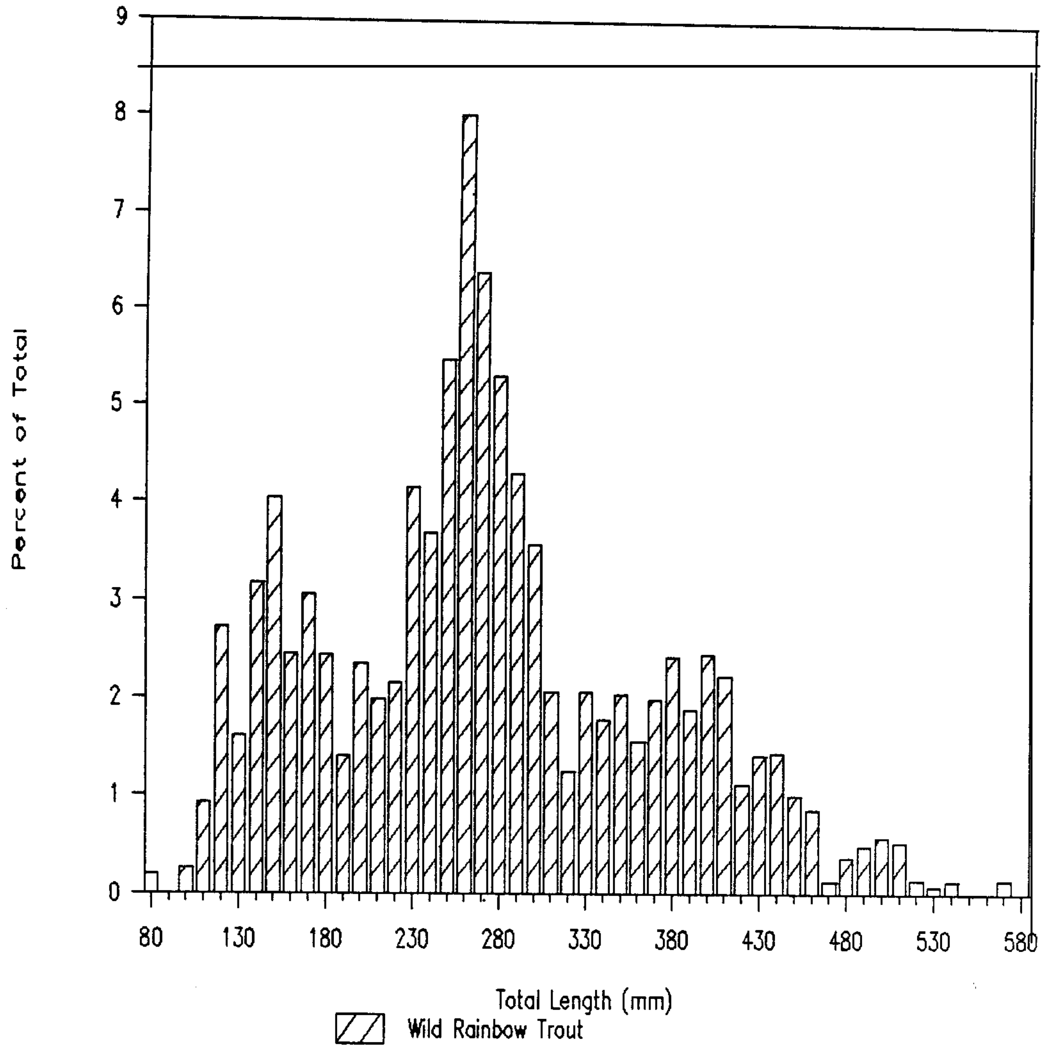

Figure 11. Length frequencies of rainbow trout captured, spring 1987 by electrofishing of all spawning study sections of Portneuf River.

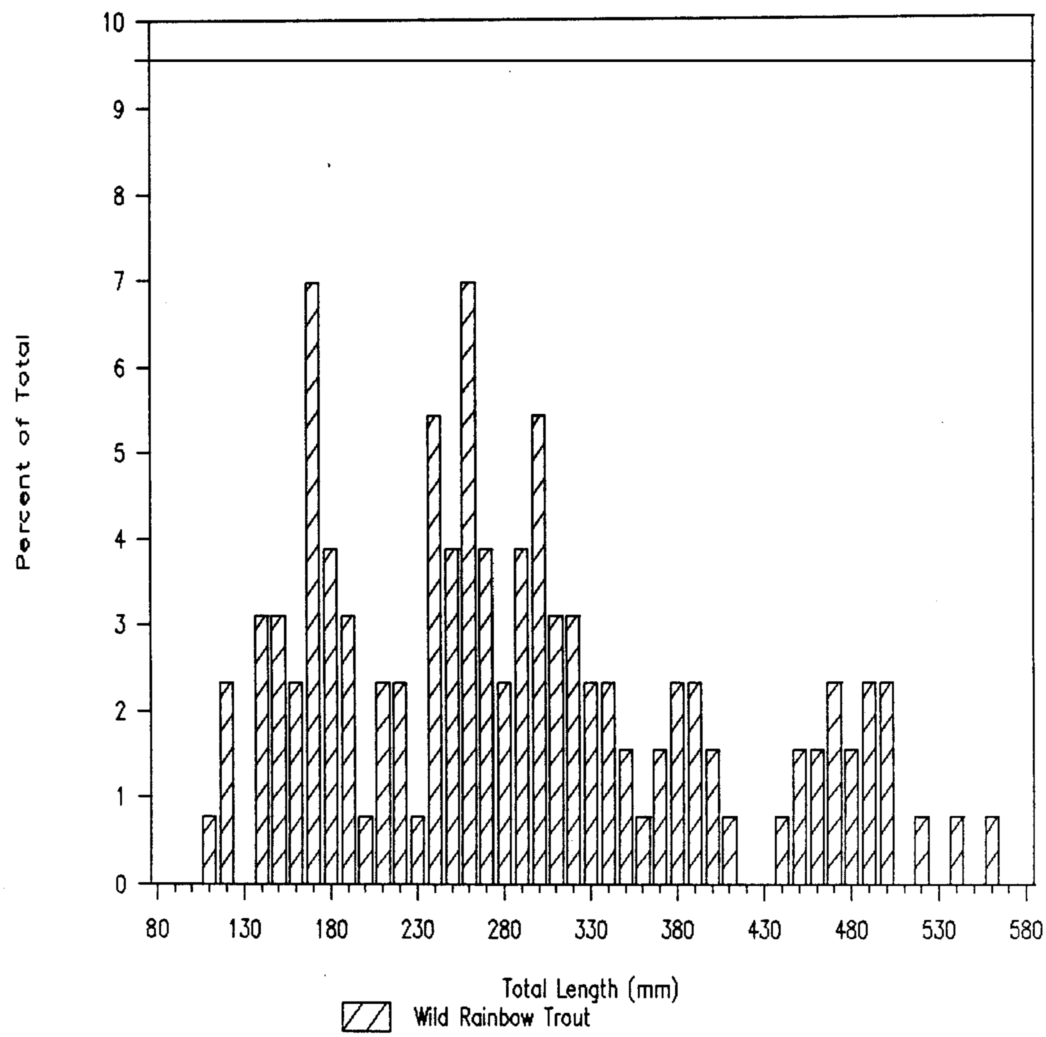

Figure 12. Length frequencies of rainbow trout captured on 12 February 1987 by electrofishing of Steel Bridge section, Portneuf River.

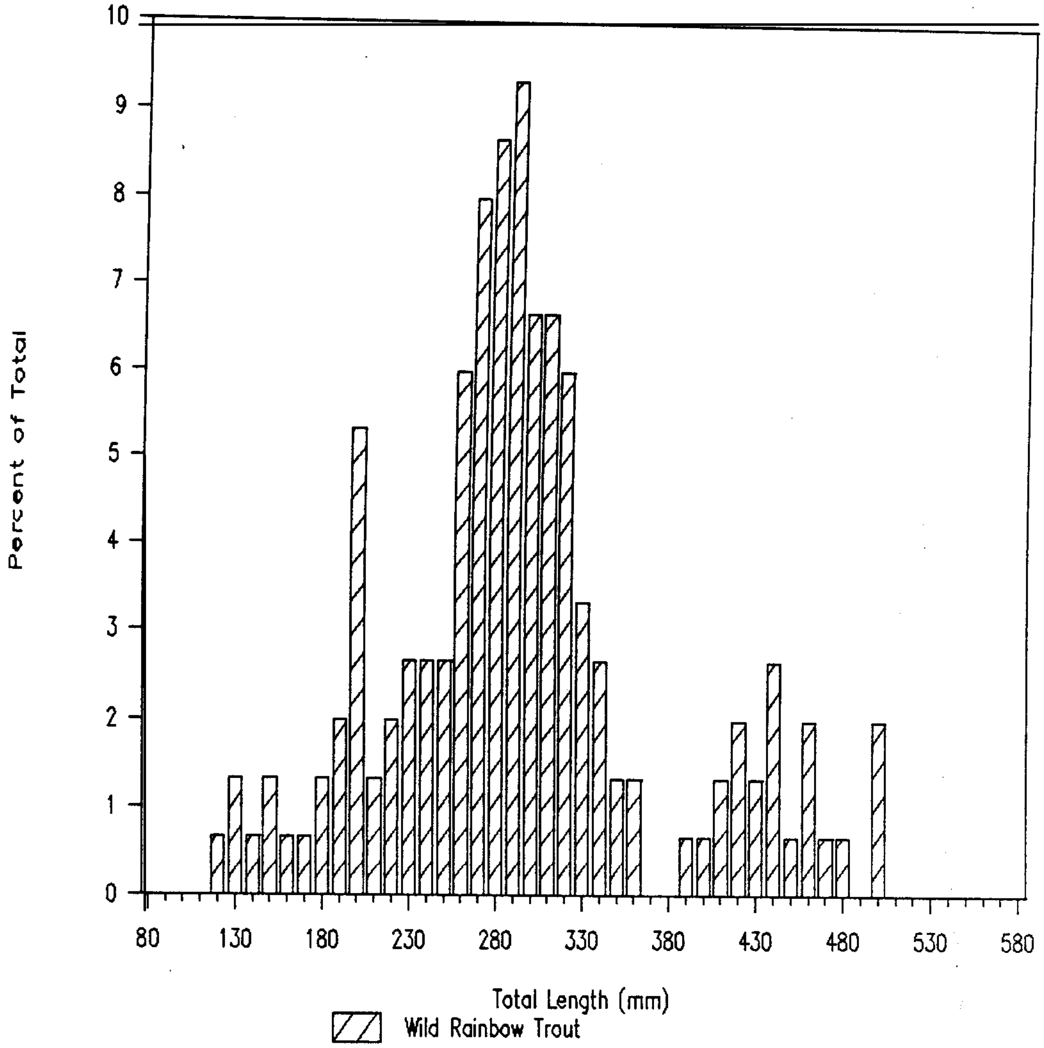

Figure 13. Length frequencies of rainbow trout captured on 29 March 1987 by electrofishing of Steel Bridge section, Portneuf River.

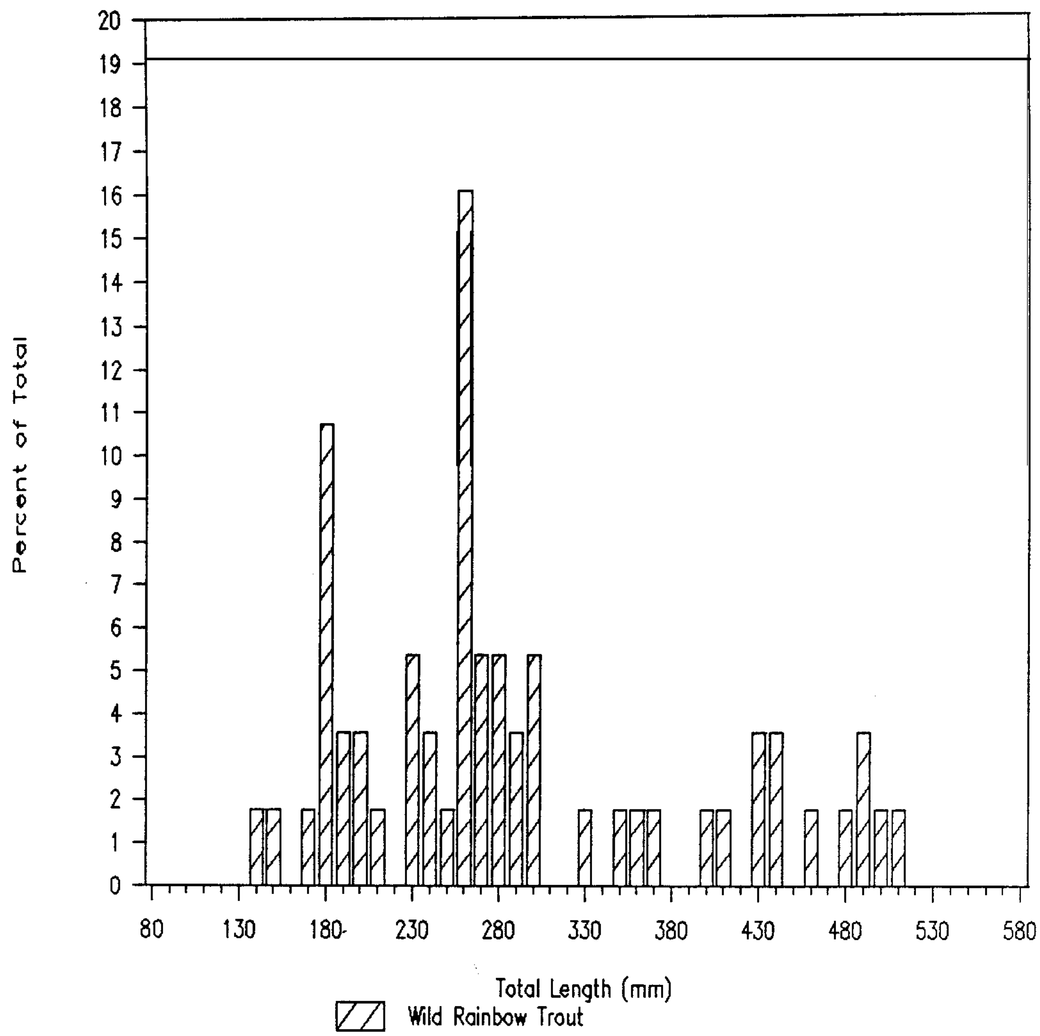

Figure 14. Length frequencies of rainbow trout captured on 31 January 1987 by electrofishing of Utah Bridge section, Portneuf River.

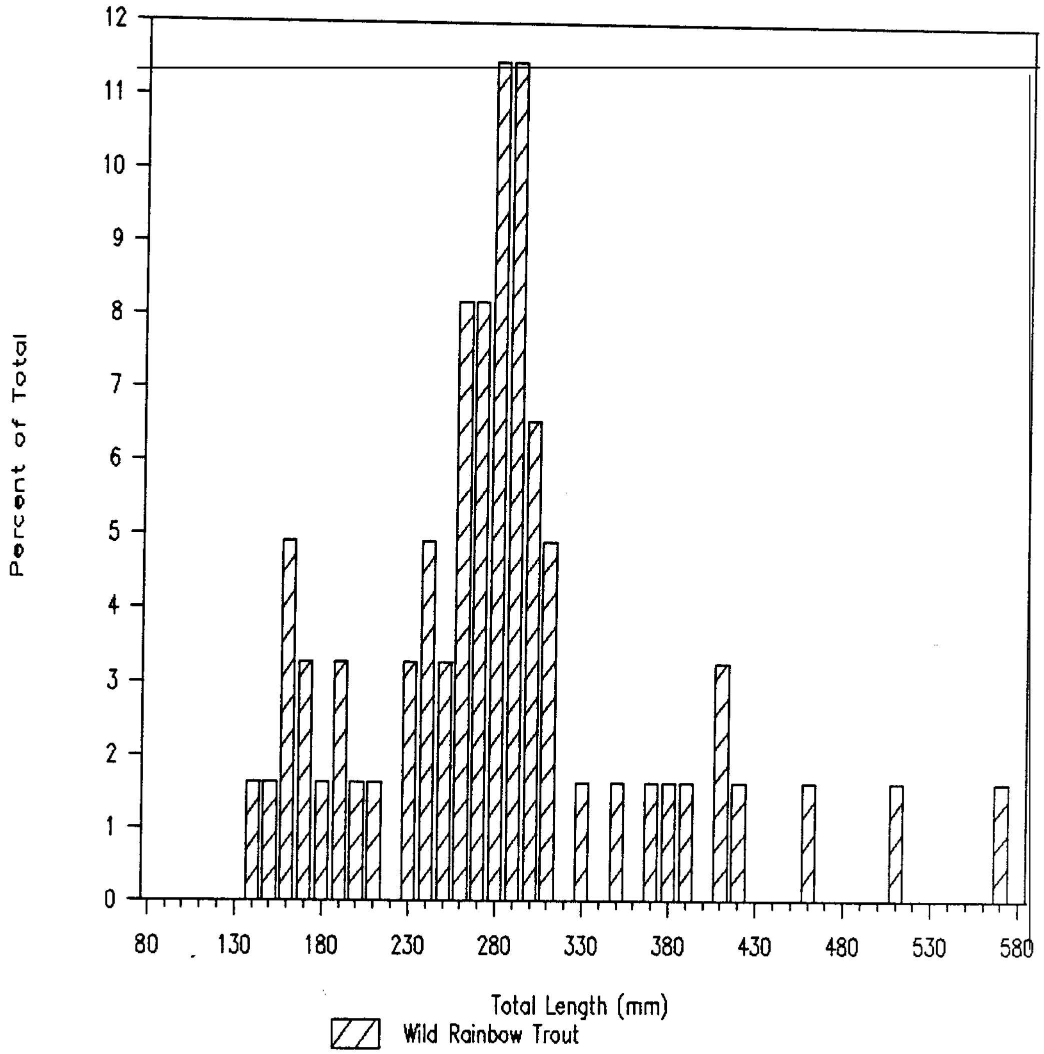

Figure 15. Length frequencies of rainbow trout captured on 30 March 1987 by electrofishing of Utah Bridge section, Portneuf River.

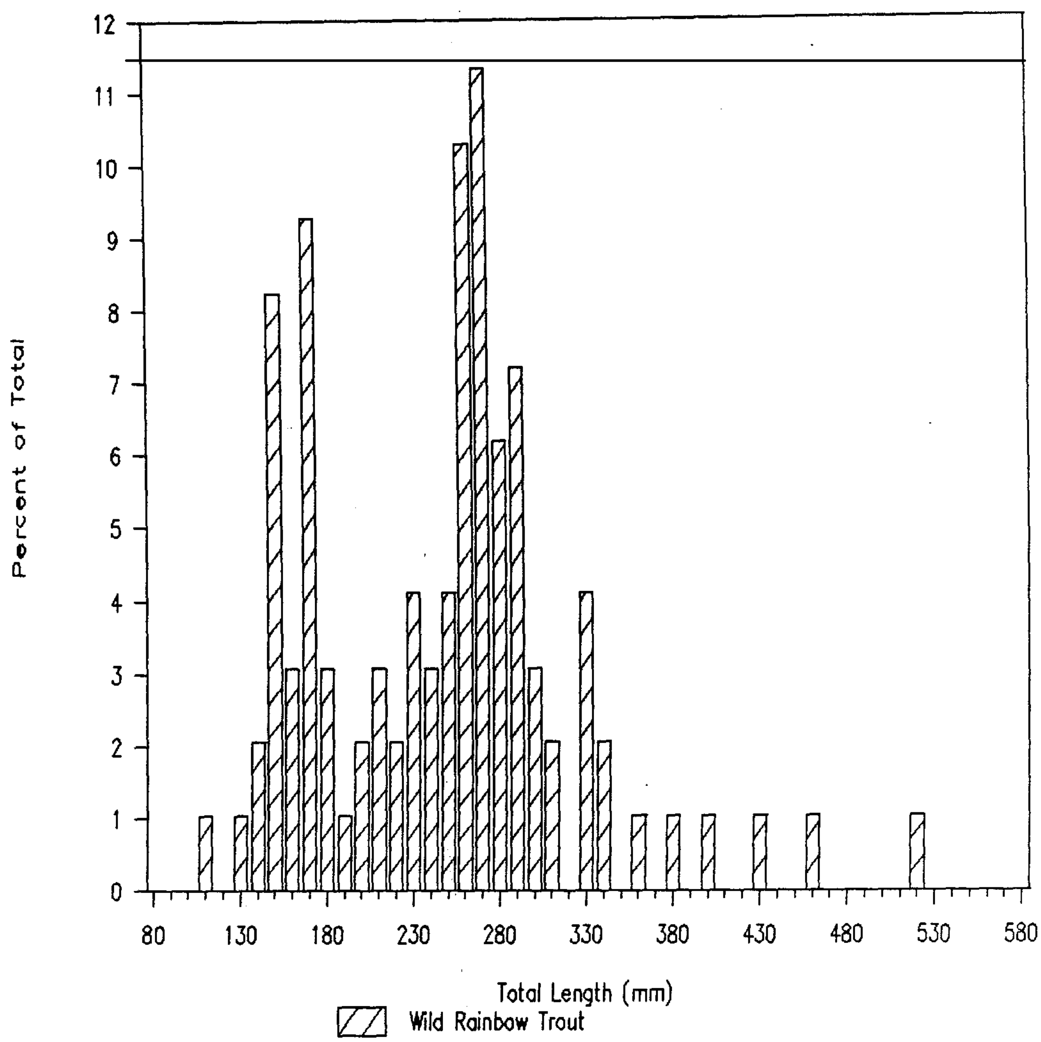

Figure 16. Length frequencies of rainbow trout captured on 30 March 1987 by electrofishing of Millward section, Portneuf River.

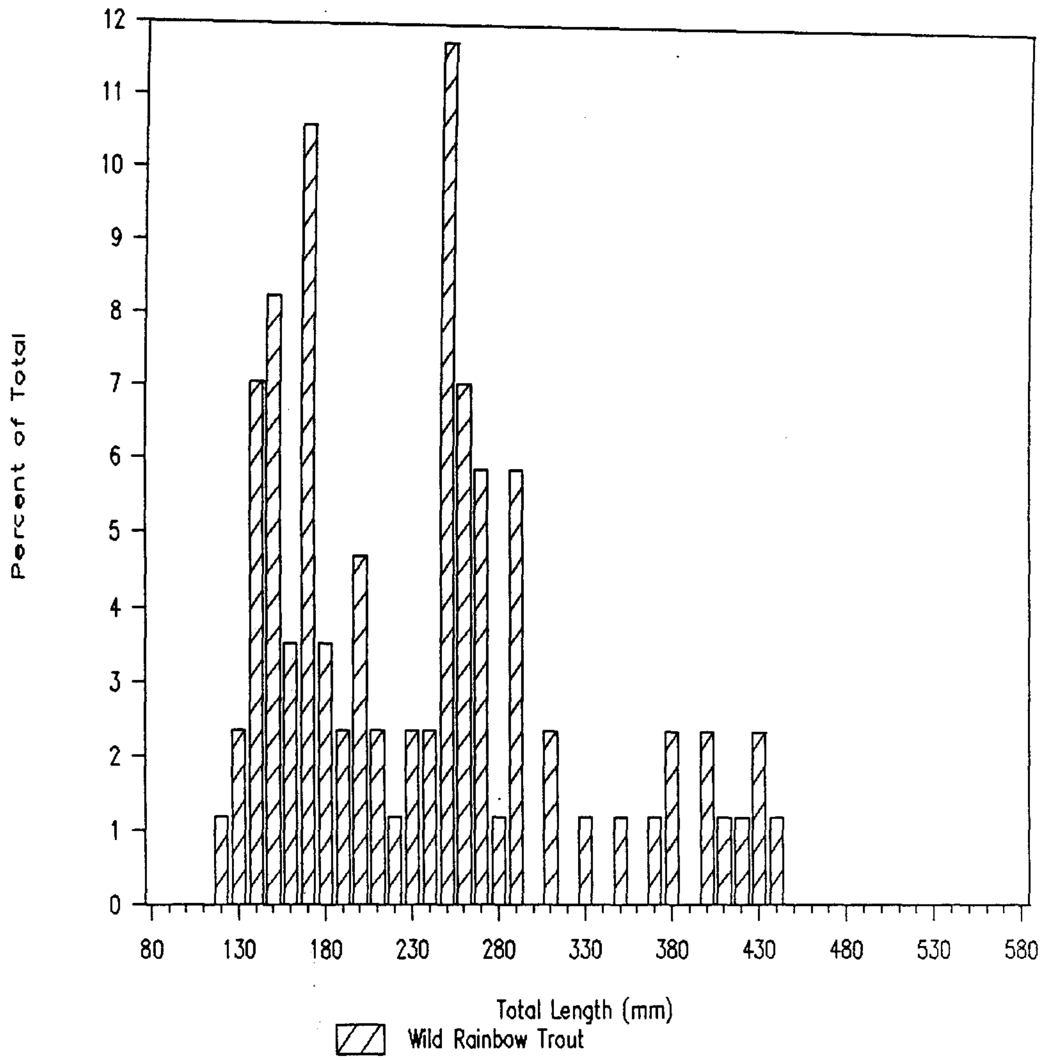

Figure 17. Length frequencies of rainbow trout captured on 31 March 1987 by electrofishing of Lime Kiln section, Portneuf River.

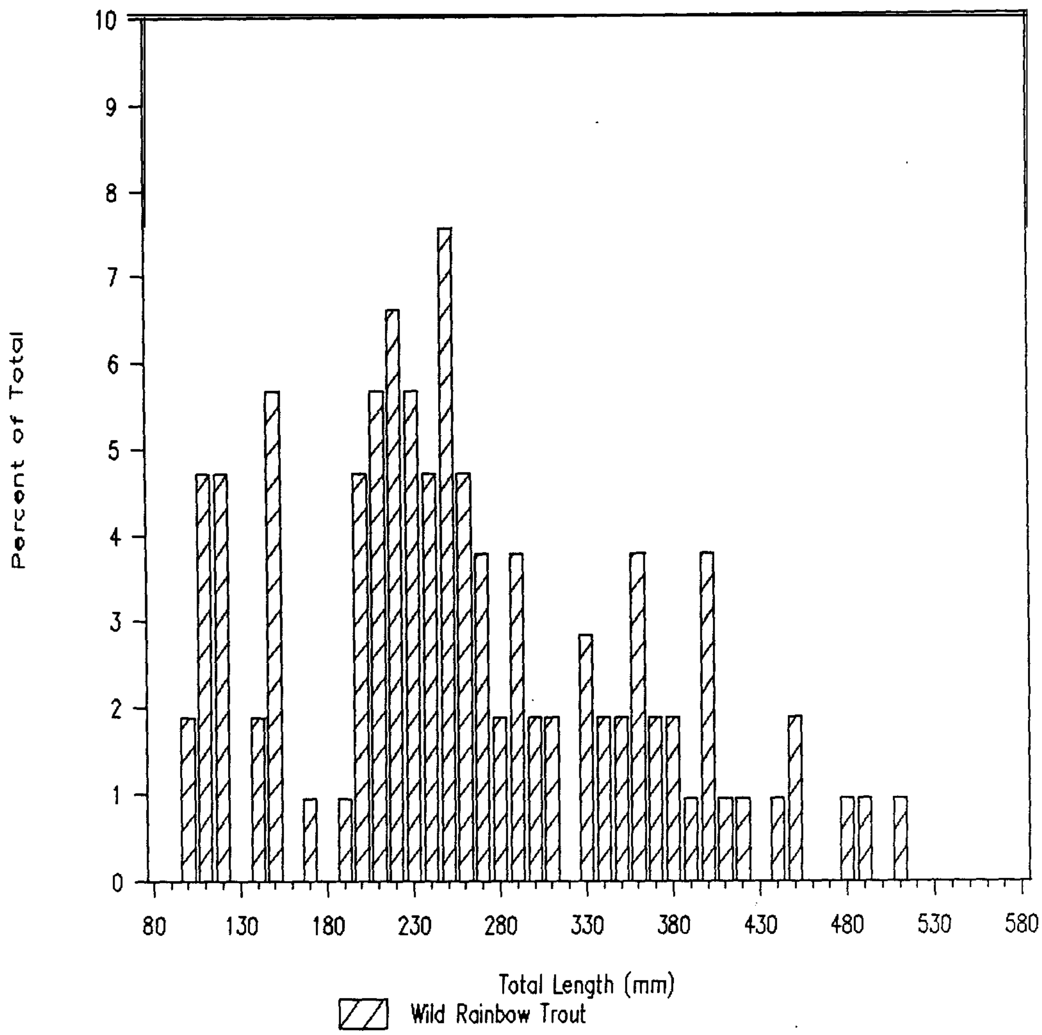

Figure 18. Length frequencies of rainbow trout captured on 31 January 1987 by electrofishing of Pebble Bridge section, Portneuf River.

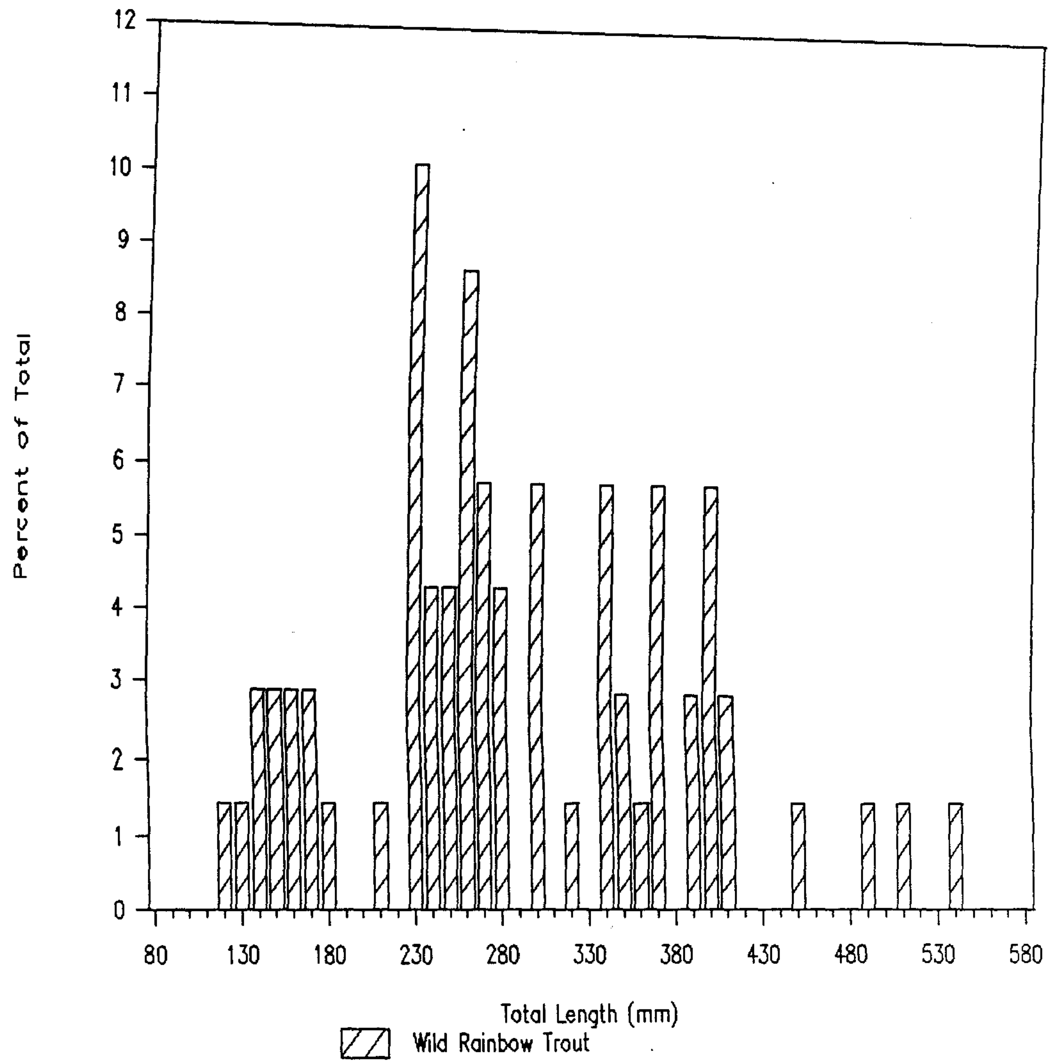

Figure 19. Length frequencies of rainbow trout captured on 31 March 1987 by electrofishing of Pebble Bridge section, Portneuf River.

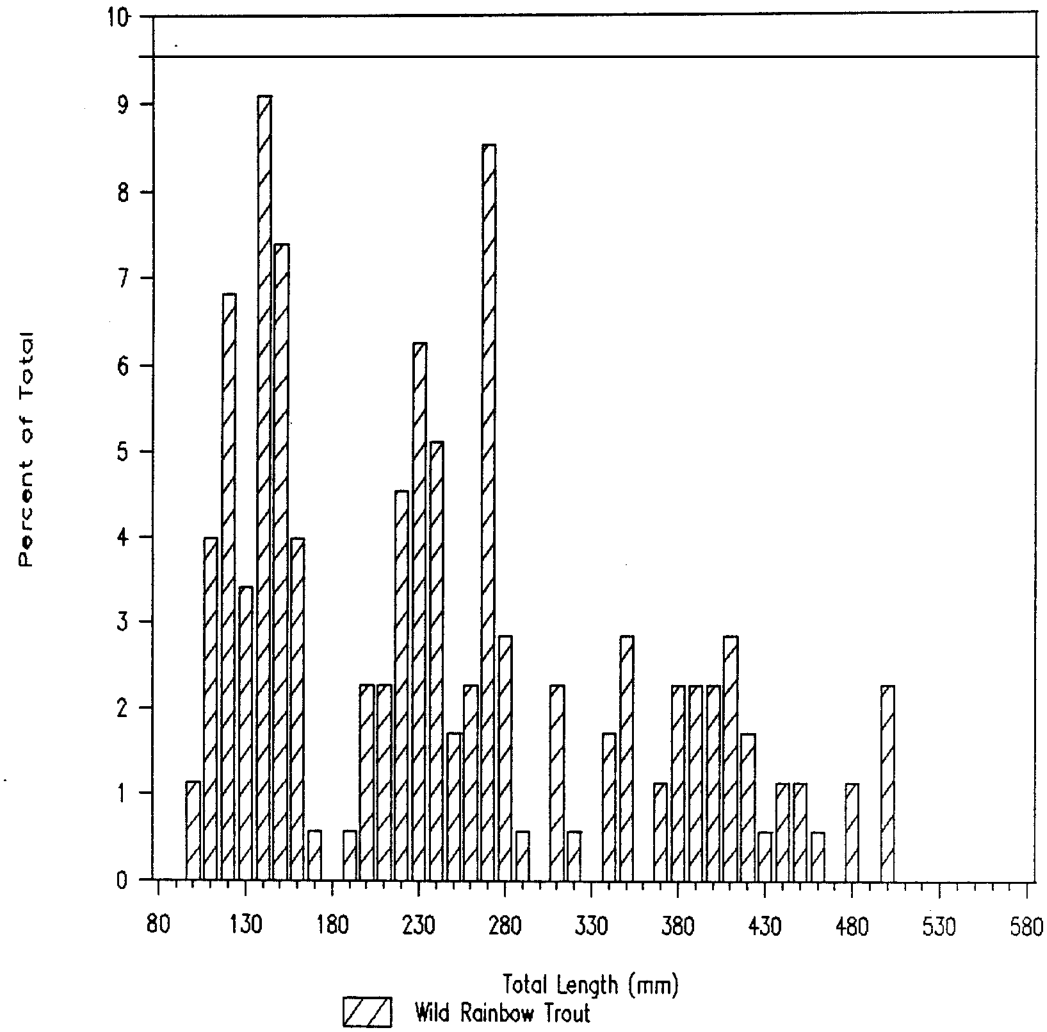

Figure 20. Length frequencies of rainbow trout captured on 7 February 1987 by electrofishing of Slaughterhouse section, Portneuf River.

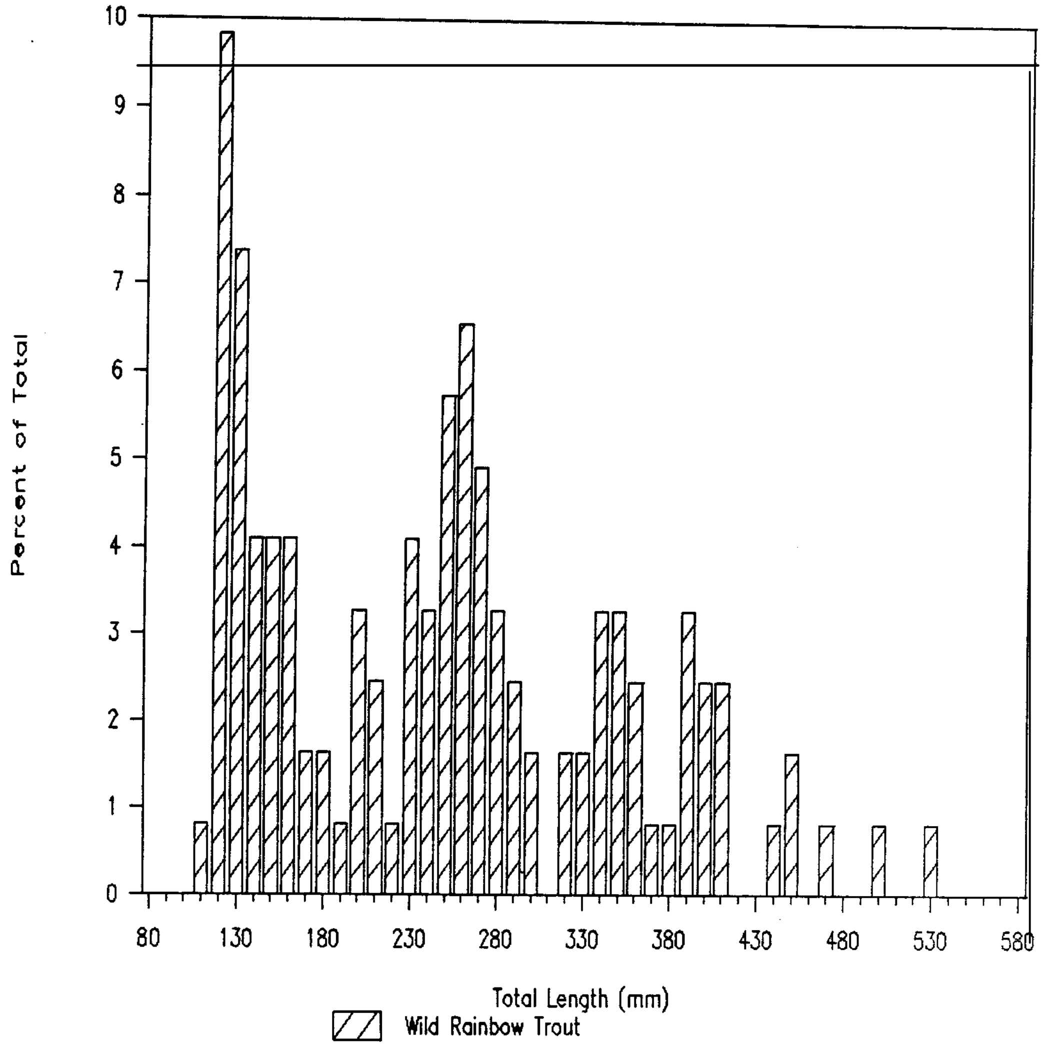

Figure 21. Length frequencies of rainbow trout captured on 17 March 1987 by electrofishing of Slaughterhouse section, Portneuf River.

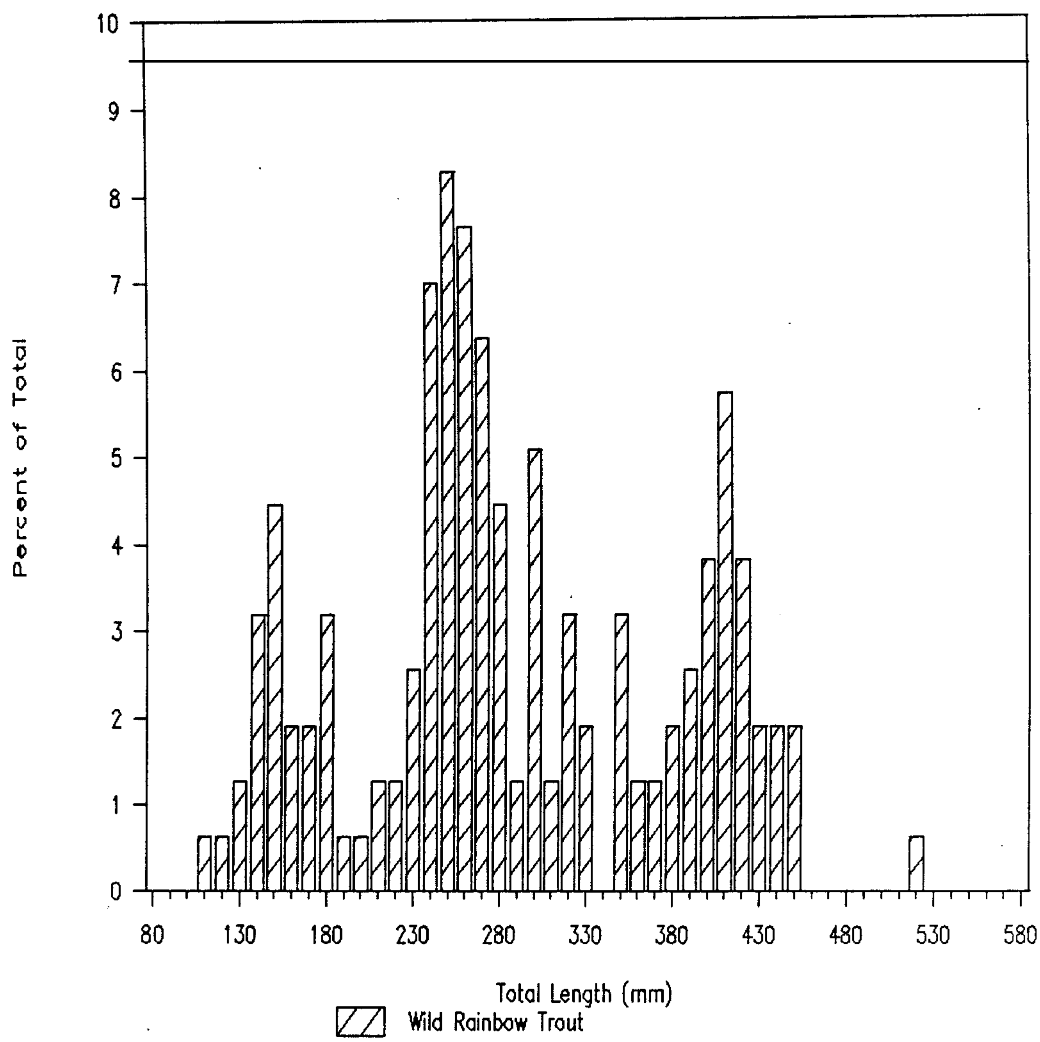

Figure 22. Length frequencies of rainbow trout captured on 7 February 1987 by electrofishing of Anderson Bridge section, Portneuf River.

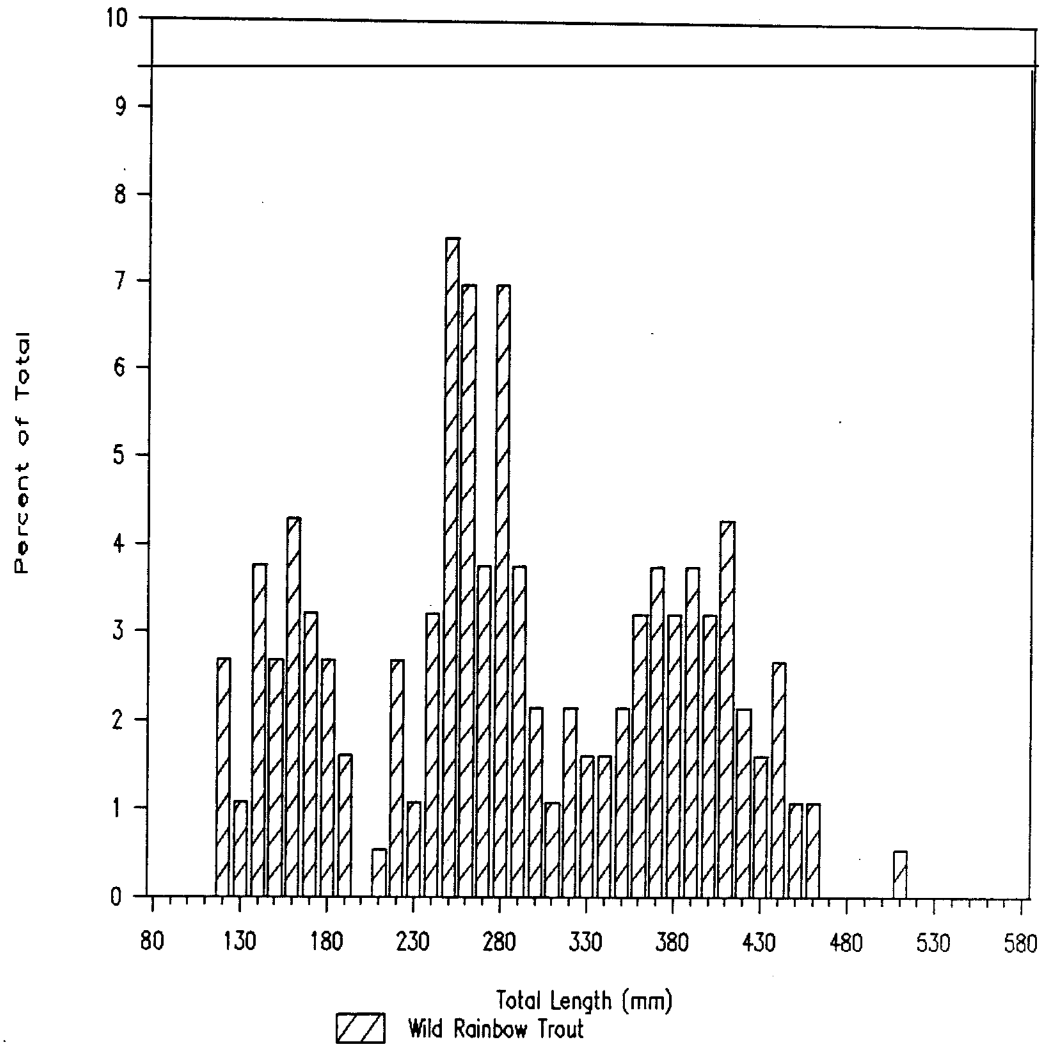

Figure 23. Length frequencies of rainbow trout captured on 17 March 1987 by electrofishing of Anderson Bridge section, Portneuf River.

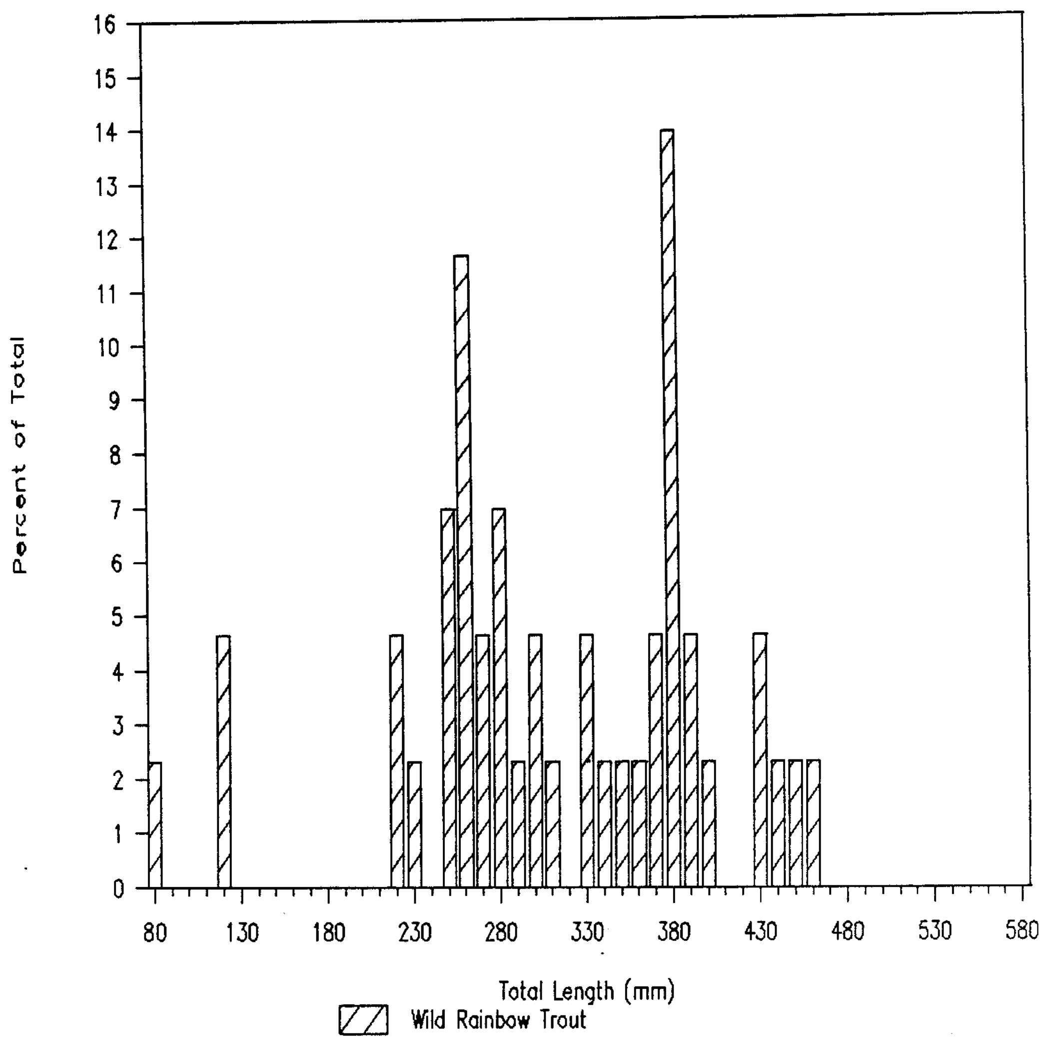

Figure 24. Length frequencies of rainbow trout captured on 8 February 1987 by electrofishing of Broxon Bridge section, Portneuf River.

Table 15. Percentage of mature wild rainbow trout collected by electrofishing the upper Portneuf River on 10 March 1987 and 10 April 1987 .

Spawning Condition Index	Percent males,		Percent females	
	March	April	March	April
#2	0	0	21	4
#3	18	0	62	2
#4	80	61	14	13
Spent	2	39	3	82
Total	100	100	100	101

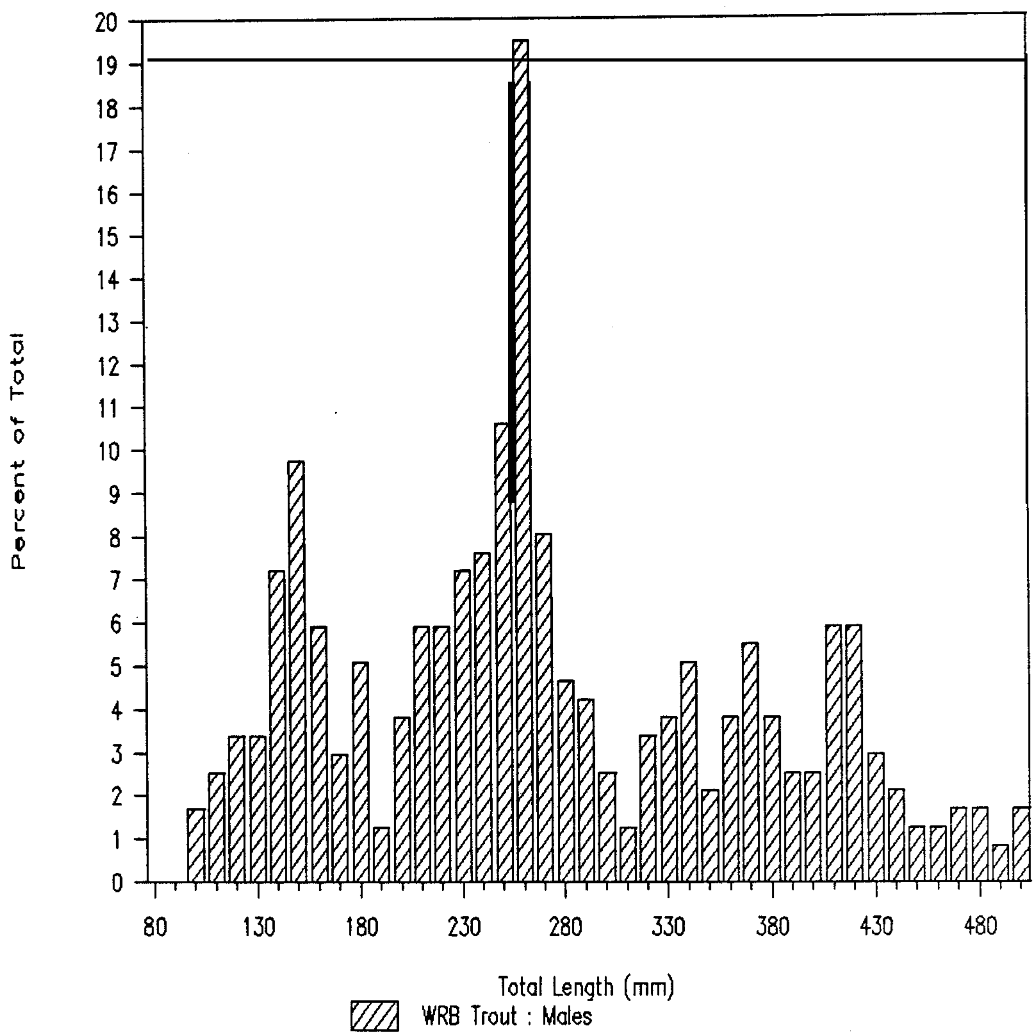

Figure 25. Length frequencies of male rainbow trout captured, spring 1987 by electrofishing of all spawning study sections of Portneuf River.

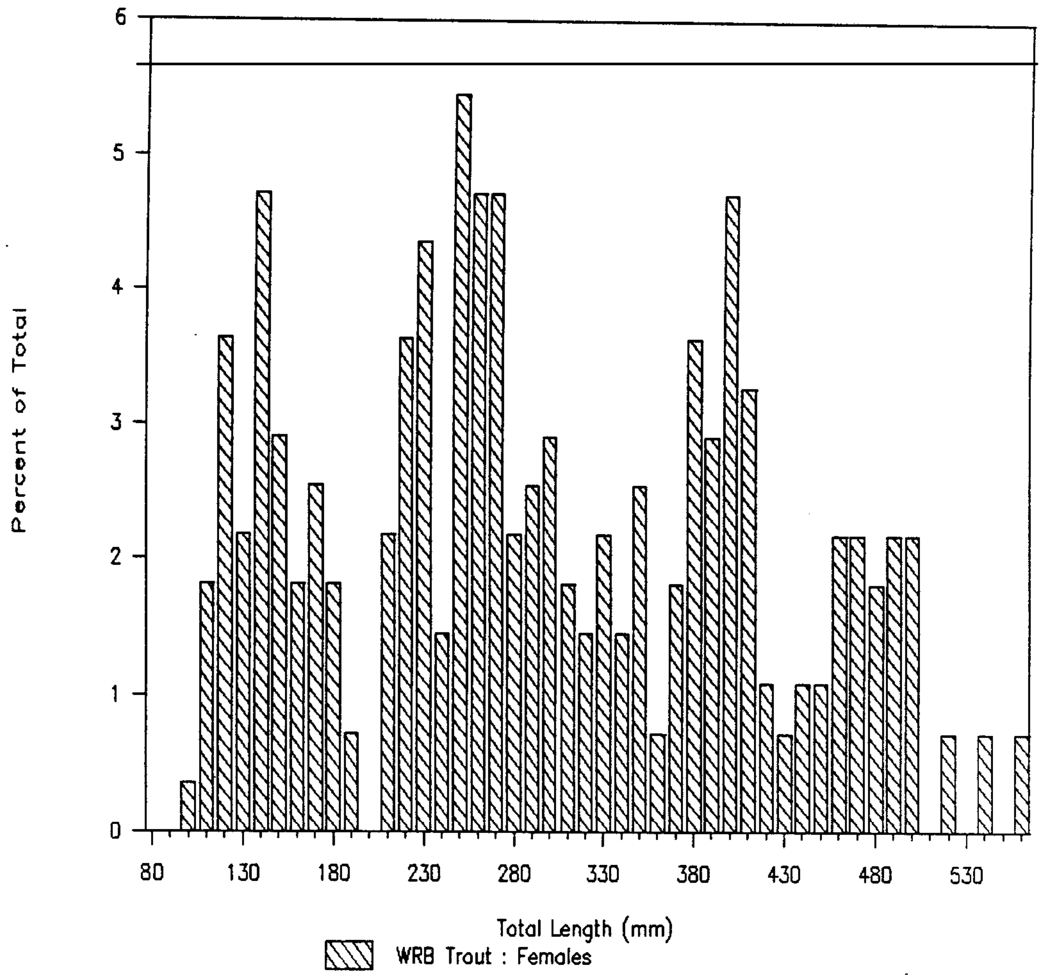

Figure 26. Length frequencies of female rainbow trout captured, spring 1987 by electrofishing of all spawning study sections of Portneuf River.

similarity of class representation for the Pebble Bridge section and below. As reported for salmonids, the males achieve spawning maturity prior to the females and retain that condition longer.

Much less than one percent of the marked individuals were recaptured from any alternative sections and no net movement to a particular location or direction was evident.

Fine Sediment in Spawning Areas

McNeil cores results of fine sediment less than 6.3 mm ranged from 88.7% at the Broxon Bridge site to 32.9% at the Anderson Bridge site (Table 16). The Steel Bridge and Broxon Bridge sites showed the highest percent levels. The Millward and Slaughterhouse sites were intermediate, with the Anderson Bridge site having the lowest values. At the Anderson Bridge site, cores were taken both within the redd and from the surrounding substrate.

The benefits of redd construction appear to be very short lived. At all sites by the end of the fourth week the amount of fines within the wooden boxes had reached or exceeded the initial levels. There was a short period immediately after introduction of the boxes in which levels of fine sediments dropped. However, this probably is a result of the scouring characteristics of the the boxes and not a characteristic of the substrate.

Embryo survival was assessed by examination of two redds each from the Slaughterhouse and the Anderson Bridge spawning areas on April 16. A total of 232 eggs were collected from the first Slaughterhouse redd, of which 24 (10%) were alive and 208 (90%) dead. Sixty-nine eggs were collected from the second redd, of which 18 (26%) were alive and 51 (74%) dead. None of the collected eggs had reached the eyed stage.

A total of 98 eggs were collected from the first Anderson Bridge redd, of which 88 (90%) were alive and 10 (10%) dead. All eggs were eyed. Eighteen eggs were collected from the second redd, of which 16 (89%) were alive and 2 (11%) dead, none of these eggs were eyed. Rising water levels and increased turbidity precluded further collections.

Percent fines present in the gravels of the redd may not be a good indicator of egg survival. Chapman and McLeod (1987) stress that without detailed information of the redd's internal structure it is difficult to relate percent fines to incubation and emergence. The laboratory results reported by Irving and Bjornn (1984) relating embryo survival to gravel mixtures (Figure 27) may not applicable to natural conditions. An increase of fine sediment in the redd does affect survival, but the exact relationships have not been established.

Table 16. Percent fine sediment smaller than 6.3 mm in diameter in McNeil core samples in the upper Portneuf River, spring 1987.

Sites	Date	Samples from redd?	% fines < 6.3 mm
Steel Bridge	2/26/87	NO	61.8
	"	"	53.2
Millward (GAWS site)	1/31/87	NO	57.8
	"	"	46.2
Slaughterhouse	2/1/87	NO	52.4
	"	"	41.1
	"	"	41.3
	2/26/87	YES	35.4
	"	"	32.9
Anderson Bridge	2/26/87	YES	38.3
	"	"	39.1
	"	"	35.0
	"	"	36.2
Broxon Bridge	2/26/87	YES	79.8
	"	"	82.2

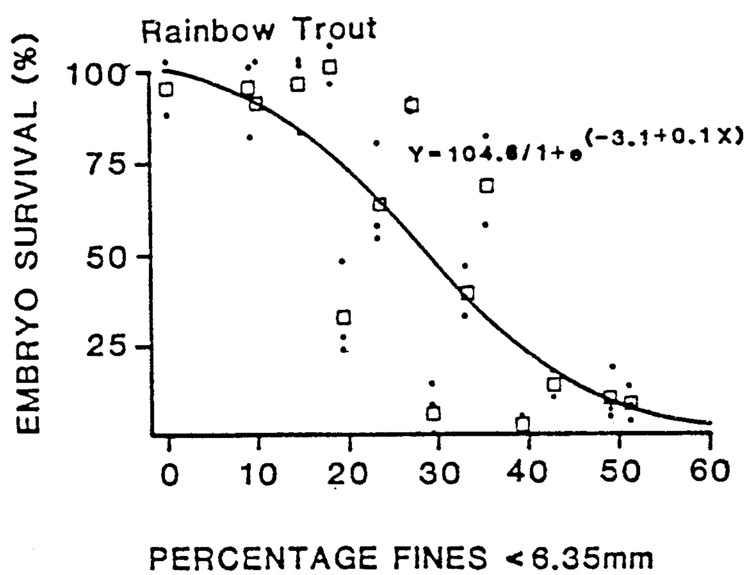

Figure 27. Rainbow trout embryo survival as a function of percent fines less than 6.35 mm in laboratory troughs of differing gravel mixes (from Irving and Bjornn, 1984).

LITERATURE CITED

Chapman, D.W. and K.P McLeod. 1987. Development of criteria for fine sediment in the northern Rockies ecoregion. Final Report, EPA Contract 68-01-6986, Boise, ID.

Frazier, W.M. 1979. Trout diet and invertebrate abundance in portions of the upper Portneuf River. unpub. report, Idaho State University, Pocatello. 71 pp.

Hoover, C. 1985. Water quality status report : Upper Portneuf River (USB-410). Idaho Department of Health and Welfare, Division of Environment. pp. 39.

Irving, J.S. and T.C. Bjornn. 1984. Effects of substrate size composition on survival of kokanee salmon and cutthroat and rainbow trout. Idaho Coop. Fish. Res. Unit Tech. Rep. 84-6.

Minshall, G.W. and D. Andrews. 1973. An ecological invsetigation of the Portneuf River, Idaho: a semiarid-land stream subjected to pollution. Freshwat. Biol. 3: 1-30.

Platts, W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for evaluating stream raparian and biotic conditions. Intermountain Forest and Range Experiment Station, Ogden, UT. General Technical Report INT-138.

Waters, T.F. 1969. Subsampler for dividing large samples of stream invertebrate drift. Limnol. Oceanogr. 14: 813-815.

Wilkosz, R. 1978. Analysis of fish scale and fish length data from a mixed trout population. Fish Ecology class project. Idaho State University, Pocatello. 20 pp.

Appendix A. Electrofishing sections, mean length(mm),(standard deviation), and total number of fish collected on the upper Portneuf River, spring 1987.

Sections	Rainbow Trout Wild	Rainbow Trout Hatchery	Cutthroat Trout
Steel Bridge	285.8 (94.3),279	301.4(48.2),86	334.2 (68.0),201
Utah Bridge	281.1 (92.0),117	273.8(24.0),13	334.8(72.6),34
Millward	241.6 (73.2),97	300.0(16.8),9	259.9(60.1),55
Lime Kiln	231.2 (82.4),85	291.2(22.3),4	276.2 (67.3),31
Pebble Bridge	269.7 (95.8),172	288.3(31.6),10	295.8(72.5),26
Slaughterhouse	242.6**(104.8),297**	251.0(17.0),3	265.5(59.6),54
Anderson Bridge	282.9 (92.7),346	301.2(41.7),8	277.8(72.4),87
Broxon Bridge	312.8 (80.1),42	289.3(117.1),3	286.7(70.7),18

Appendix B. Percentages of mature male wild rainbow trout in selected size intervals.

Section	N	Total Length (mm) <200	200-320	320-470	>470
Steel Bridge	23	17	48	35	0
Utah Bridge	14	7	86	7	0
Millward	6	17	67	0	17
Lime Kiln	4	50	25	25	0
Pebble Bridge	57	28	42	26	4
Slaughterhouse	46	30	41	22	7
Anderson Bridge	75	25	41	33	0
Br.oxon Bridge	9	0	33	67	0

Appendix C. Percentages of mature female wild rainbow trout in selected size intervals.

Section	N	--------------Total Length (mm) -----------			
		<200	200-320	320-470	>470
Steel Bridge	55	16	35	44	20
Utah Bridge	11	82	18	0	0
Miliward	4	0	75	25	0
Lime Kiln	6	67	33	0	0
Pebble Bridge	29	21	61	14	4
Slaughterhouse	56	42	35	22	2
Anderson Bridge	**86**	21	38	41	0
Broxon Bridge	15	7	53	40	0

Appendix D. Metal jaw tag information from upper Portneuf River, spring 1987.

Tag No.	Trout Species	Size(mm)	Sex	Mark	Date & Location Tagged	
C 5502	Cutthroat	431	F	Anal Clip	3/29/87	Steel Bridge
C 5503	Cutthroat	411		Anal Clip	3/29/87	Steel Bridge
C 5504	Cutthroat	411		Anal Clip	3/29/87	Steel Bridge
C 5505	Cutthroat	438		Anal Clip	3/29/87	Steel Bridge
C 5594	Cuttroat	382	F	Top Caudal	3/17/87	Anderson Bridge
C 5596	Wild Rainbow	391	F	Top Caudal	3/17/87	Anderson Bridge
C 5597	Wild Rainbow	332	M	Lo Caudal	3/17/87	Slaughterhouse
C 5598	Wild Rainbow	494	M	Dorsal	3/17/87	Broxon Bridge
C 5599	Wild Rainbow	448	F	Lo Caudal	3/17/87	Slaughterhouse
D 302	Wild Rainbow	162		Lo Caudal	3/17/87	Slaughterhouse
F 1002	Wild Rainrow	263		Lo Caudal	3/17/87	Slaughterhouse
F 1003	Wild Rainbow	215		Mid Caudal	3/17/87	Pebble Bridge
F 1004	Wild Rainbow	264		Lo Caudal	3/17/87	Slaughterhouse
F 1005	Wild Rainbow	236		Mid Caudal	3/17/87	Slaughterhouse
F 1006	Wild Rainbow	230		Top Caudal	3/17/87	Anderson Bridge
F 1007	Wild Rainbow	256		Anal Clip	3/29/87	Steel Bridge
F 1009	Cutthroat	322		Anal Clip	3/29/87	Steel Bridge
F 1043	Wild Rainbow	225	M	Dorsal	3/17/87	Broxon Bridge
G 0302	Wild Rainbow	326	M	Anal Clip	3/29/87	Steel Bridge
G 0303	Cutthroat	342		Anal Clip	3/29/87	Steel Bridge
G 0304	Cutthroat	375		Anal Clip	3/29/87	Steel Bridge
G 0398	Cutthroat	295	F	Top Caudal	3/29/87	Anderson Bridge
G 0399	Wild Rainbow	251		Lo Caudal	3/17/87	Slaughterhouse

Appendix E. Population estimates for individual sections of the upper Portneuf River, spring 1987.

Sections	Number Marked	Number Recatured	*Population Estimate (N)	+95% C.I.
Steel Bridge	274	30	2748	2066 - 4103
Utah Bridge	79	2	2475	1287 - 32,481
Pebble Bridge	122	5	2094	1219 - 7461
Slaughterhouse	201	10	2924	1888 - 6481
Anderson Bridge	195	12	3855	2550 - 7898

$$* : \hat{N} = \frac{M(C + 1)}{(R + 1)}$$

$$+ : 95\%\ C.I. = \sqrt{\frac{R(C - R)}{(M^2)(C^3)}} \; .$$

Appendix F. Population estimate for combined sections of the upper Portneuf River, spring 1987.

	M	C	R	$\hat{N}$	95% C.I.
Wild Rainbow	624	782	33	14,370	10,858- 21,277
Hatchery Rainbow	63	57	8	406	257 - 969
Cutthroat	184	242	18	2,353	1,653 - 4,083
All Species	871	926	59	13,501	10,849- 17,866

* : $\hat{N} = \frac{M(C + 1)}{(R + 1)}$

+: $95\%\ C.I. = \sqrt{\frac{R(C - R)}{(M^2)(C^3)}}$

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